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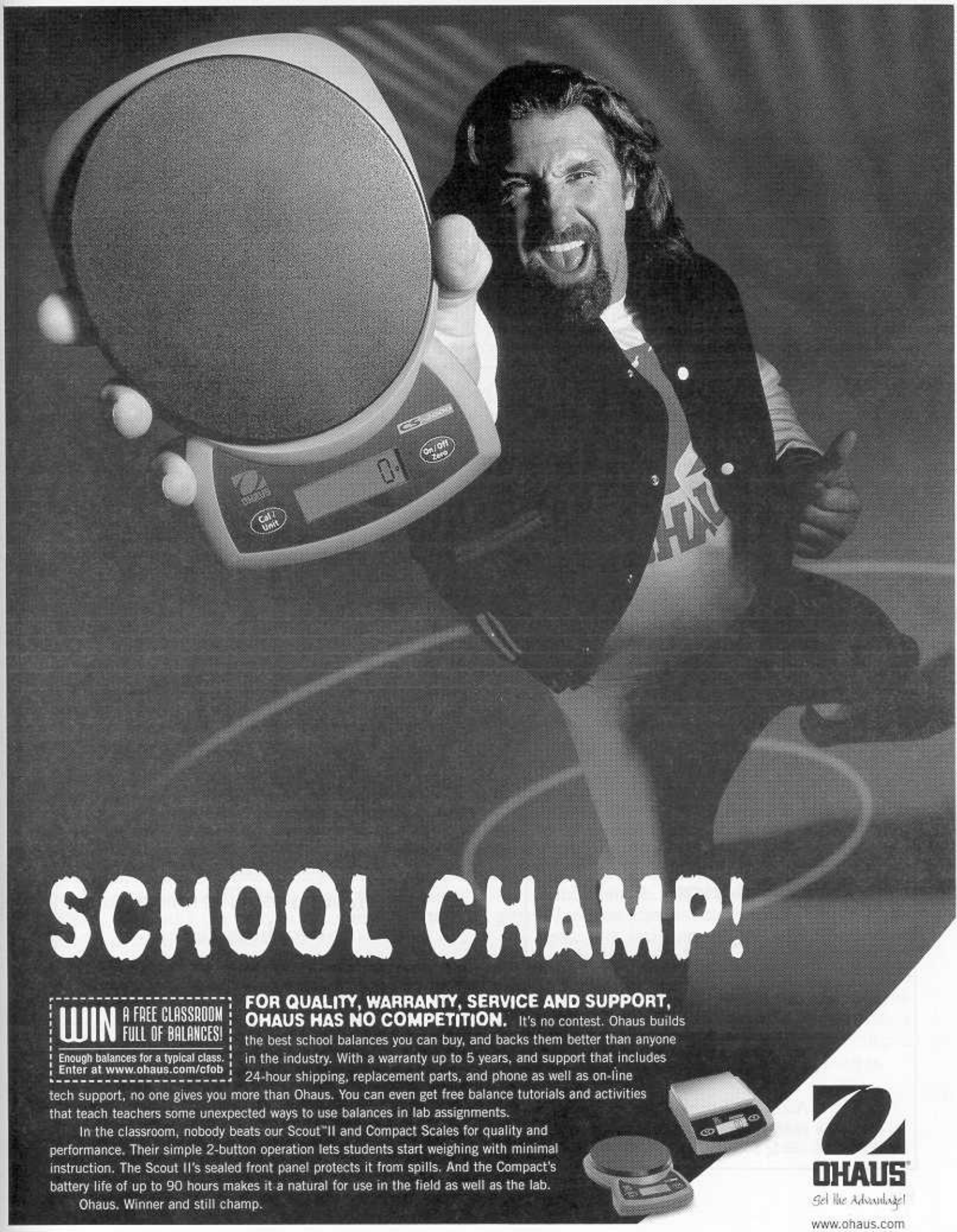
"*Literary or scientific, liberal or specialist, all our education is predominantly verbal and therefore fails to accomplish what it is supposed to do. Instead of transforming children into fully developed adults, it turns out students of the natural sciences who are completely unaware of Nature as the primary fact of experience, it inflicts upon the world students of humanities who know nothing of humanity, their own or anyone else's.*"—Aldous Huxley

The present issue of the Journal contains a series of four related papers, each of which focuses on a particular aspect of the insect biology of a natural preserve, the Helen Moyers Biocultural Reserve in Yucatan, Mexico. Collectively, they represent the first descriptions of and scientific outcomes from a burgeoning experiment in experiential learning that is being undertaken by the faculty of the Department of Biology at Millsaps College. The first of these is a general description of the Reserve and the process that led to initiation of the experimental collections. The remaining three of the four were written by the undergraduate students who performed the research and co-authored by a Millsaps faculty member. It is still relatively unusual, although certainly not unheard of, for this Academy to publish manuscripts written by undergraduate students. However, the development of the Biocultural Reserve, with an impetus that is almost exclusively educational in its orientation, comprises such a bold and far-reaching effort that it deserves particular attention. A specific intent, as outlined in the initial report by Dr. Armstrong, is to develop the Reserve as a training ground for students in the ecological, biological, botanical, and in the archeological sciences. Understated in her descriptions is the fact that much, if not most, of the learning that will take place by students will be in communication and interpersonal skills, self-confidence, independence and reflection. In other words, personal growth of an enduring, life-long nature. Surely, this is an exemplar of an educational structure to which we all aspire.

The review process for these manuscripts has identified a relative lack of sophistication to the scientific rigor of the entomological accounts. This Journal utilizes an editorial oversight and system of extremely qualified scientists, who are dedicated to maintaining the highest possible standards in the material accepted for publication. However, in the opinion of this Associate Editor, the power of the ideas that underlie the creation and use of the Reserve, and the processes of education that are inherent to those students who have worked and will work in studies there, make the reports in question of unique value. Just as the gestation, birth and early development of a new organism require modification of the life-style and thought processes of the parents (and those surrounding the parents), the implementation of an educational paradigm involving students who utilize the resources of the Reserve demands certain initial compromises. Without question, as grows the sophistication of the scientific endeavor begun so boldly, and on such limited resources, so also will grow the expectations of the scrutiny that will be applied to the science that results. The faculty and students who began this odyssey, and the reviewers who facilitated the publication path are to be congratulated.—Rob Rockhold, Associate Editor



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Initiating a Field Biology Program for Undergraduates

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Starting a new field biology program at a location remote from one's home campus is a complex undertaking. Considerable advance planning is necessary to bring the site, the equipment and the people together in a productive working arrangement. To start a field program in an isolated rural area in another country, with the attendant problems of language, cultural differences, and transporting personnel and equipment across international boundaries, increases the logistical difficulties immensely. In the summer of 2002, my colleague Jim McKeown and I initiated a field biology research program for undergraduates at the Helen Moyers Biocultural Reserve in southern Yucatan, Mexico. The purpose of the program is two-fold: to introduce undergraduate students to research methods in field biology, and to begin a baseline biological survey of the property encompassed by the Reserve.

***Requirements of the Program*—**Undergraduate students planning to work at the Reserve are assigned a problem that fits their interests and background in biology. The project may be carried out as part of the general Undergraduate Research program offered by Millsaps, or, if the students qualify, as part of the Honors Program or the Ford Fellowship Program. Each student is required to complete an extensive review of the available literature for their problem during the spring semester prior to the summer field season. In the field, students are expected to collect, identify, and preserve their specimens, and maintain accurate field notebooks. Upon returning to Jackson, each student writes a formal report of their findings in the standard format for a research report. Students are evaluated on the appropriate use of the literature, the quality of their collections and identifications, and their final research report. Collections will be housed at Millsaps College, with duplicates at Universidad Autónoma de Yucatán, per agreement with the Mexican government.

Students are responsible for travel expenses and costs in the field. Millsaps students needing financial assistance may apply for a Biology Field Research Fellowship administered through the college. We encourage our students to obtain passports if they do not already have one (applications available through the post office or at www.state.gov/travel, current cost $85 plus photograph), although a certified birth certificate with photo ID is accepted by the U.S. Immigration Service for return to the United States. Visa forms are distributed by the airline, and are included in the ticket price.

Although there are currently no specific health advisories in effect for the area, we encourage our students to take the obvious precautions of using a DEET-based insect repellent, drinking only bottled water or other beverages, and eating only cooked fruits and vegetables or those that they peel themselves. The Centers for Disease Control (www.cdc.gov/travel) also recommends that travelers to Mexico be vaccinated against Hepatitis A, tetanus, and rabies. We also require everyone in the group to have health insurance that is valid outside the United States, such as a policy designed for students studying abroad (e.g, www.studyabroadinsurance.com).

***History of the Reserve*—**In 2001, Millsaps College established the Helen Moyers BioCultural reserve on 1200 ha of second-growth dry tropical forest in central Yucatan State to be used as an outdoor laboratory for research in archaeology and biology. On old maps of the region, the area is designated "Rancho Kiuic", one of several sites in the Puuc Hills region of Yucatan known to contain ruins of Mayan buildings. Funding from the Moyers family made possible the purchase of the land and the establishment of infrastructure supporting the vision of a multidisciplinary field research facility that would allow students and faculty to carry out research projects in a variety of fields, including archaeology, biology, geology, and sociology. The Helen Moyers Biocultural Reserve is managed by Kaxil Kiuic, A.C., a Mexican non-profit organization that seeks to develop educational programs on-site and to promote strategies for development of the research activities in a manner consistent with ecological and cultural preservation. The term "biocultural" was coined to convey the sense of multidisciplinary studies that the preserve embodies. The site, which now encompasses 1900 ha, presents numerous opportunities, not only in traditional disciplines such as archaeology and biology, but also for collaboration among various fields, such as ethnobotany or natural products chemistry, and thus offers possibilities for truly integrative studies not

usually available to undergraduate students. The Reserve is located in a remote, rural region of Yucatan state (Figure 1), and has not been used for agriculture or grazing for over 100 years.

***The Setting*—**The Yucatan Peninsula of Mexico is characterized by porous limestone covered by thin, rocky soil. The land is fairly flat, except for a line of hills, the Puuc Hills, running northwest to southeast from the state of Campeche into western Yucatan State. There is very little surface water, as precipitation percolates rapidly through the limestone to collect in underground caves and streams, which occasionally break through to the surface as *cenotes*, or sinkholes. The original Mayan inhabitants of the region used the natural *cenotes* as a means of conserving water, or constructed artificial *chultuns* or underground cisterns to collect and retain water through the long dry months. Several *cenotes* and *chultuns* are found in the Reserve.

The climate of central Yucatan is subtropical, with alternating wet and dry seasons of about six months each. The wet season lasts from about late June through December, with nearly daily torrential rains. The climate tends to be quite warm year-round, with summer temperatures in the vicinity of 30°C mid-day and around 20° at night. Winter temperatures are in the 15–25°C range.

***Facilities*—**At present, no laboratory facilities or living accommodations exist on site. Plans are being developed to create a living and learning environment that will promote interdisciplinary discussion and new collaborations by creating a community of research spaces, library, dormitories, dining commons and recreational space where principal investigators and students can live and work together. The research station will be designed to minimize impact on the fragile ecosystem of the area.

***Initiating Biological Research at the Reserve*—**Dr. McKeown and I made two exploratory visits to the area, in June of 2001 and in January of 2002 in order to see the reserve at different seasons. The rainy season began later than usual in 2001, so our visit coincided with the end of the dry season. Vegetation was tinder-dry, and we saw little evidence of animal life other than snakes and lizards. At our January visit, the rainy season had just ended. The vegetation was thick and lush, a sharp contrast to what we had seen on our earlier visit. On this second trip, we learned of the possibility of staying at Hacienda Tabi, and upon our return to Jackson, we were able to contact the *Fundación Cultural Yucatán* (Yucatan Cultural Foundation), a non-profit organization that owns and is restoring Hacienda Tabí as an educational center, to make arrangements to bring a group of students to live and work at Hacienda Tabí the following June.

In June, 2002, we and a group of five undergraduates flew to Mérida, rented a van, purchased hammocks, mosquito nets and a few supplies, and drove the 120 km to the hacienda to set up a field laboratory from which we would begin a base-line study of the flora and fauna at the Helen Moyers BioCultural Reserve. The 2002 field season at the Reserve was our first opportunity to explore the biota of the area in any depth. It was also the first time abroad for most of our students, and the first opportunity for most of them to do field research. Of the group, only I spoke Spanish, while most of the people we encountered spoke either Spanish or Mayan. Thus there were many challenges to be met for all of us.

The hacienda is about 20 km straight-line distance from the Moyers Reserve, but about 35 km by road. We had little idea what to expect at Tabí, since we had only seen the outside of the building on a previous visit to the area. We knew there was running water and electricity, but that was all.

Our first task was to create a living and working space at the hacienda. The resident caretakers offered us two rooms that had been a library and a storage area to use as lab space. With the addition of some trestle tables and a few folding chairs, we had the beginnings of our laboratory.

All the equipment and supplies we needed we had to bring with us. Dissecting and compound microscopes, illuminators, collecting nets, killing jars, pinning boards, plant presses, insect and plant keys and other reference books were packed into seven large crates and shipped as checked luggage when we flew into Mérida, the airport nearest Hacienda Tabí and the Reserve. Chemicals such as ethyl acetate and ethanol we purchased in Mérida.

Living arrangements were simple. The students slung hammocks from hooks set into the wall of the deep gallery along the front of the building. The two faculty were given a separate room fronting on the gallery. We ate as the caretakers' family ate, and were introduced to many traditional Mayan and Yucatecan dishes.

Our primary goal in this first season was to initiate a baseline survey of the insect diversity at the Moyers Reserve. Of the five students in our group, four collected insects, each taking responsibility for a different order: Robert Caskey (Diptera), Barrot Lambdin (Hymenoptera), Jim Goode (Coleoptera),

and Robert Freeman (general diversity). The fifth student, Dionne Jackson, collected and identified flowering plants and pollen to begin a catalog of plants currently found in the area. Pollen will be photographed using a scanning electron microscope and compared to pollen grains found in the soils removed from the archaeological sites being excavated on the property to determine the types of plants available to the populations originally inhabiting those sites.

The rainy season had just begun when our group arrived in Yucatán. The weather during our stay in the area was quite predictable: clear and hot in the morning, with torrential rains in the afternoon. This dictated our work schedule, which was to rise early so as to get to the field site by 0800, work until about 1300, then spend the afternoon and evening in the laboratory identifying and preserving the collections.

Since Hacienda Tabí is owned by the *Fundación Cultural Yucatán*, one of the requirements of using the facility is to contribute some form of community service to the hacienda. Our students chose to make a collection of insects found on the hacienda lands that could be used in teaching school groups that visit the hacienda. While making these collections, they began to wonder how much difference there was between the insect populations they were sampling at the Reserve and the insect populations at the hacienda, which is surrounded by orchards and vegetable fields. What had started as a simple survey of the insects at the Moyers Reserve took on a new character as they began collecting additional specimens at the hacienda itself.

Benefits of Undergraduate Field Research—The logistics of mounting a new field biology program in another country, especially one involving relatively inexperienced undergraduates, are complex and resource-intensive, but such a program can also be very rewarding. The scientific opportunities at the Moyers Reserve are many and varied, and the experience of living and working in unfamiliar and less than ideal conditions challenges one to develop talents and abilities previously underdeveloped or unsuspected.

Our students learned not just about the organisms they had chosen to study, but how to live and work in a culture very different from their own, how to communicate effectively even though they did not speak the local language, and how to improvise as needed to complete a task successfully. They grew as scientists and as people.

Of the students who participated in this first field season, Robert Caskey and Robert Freeman are enrolled at the University of Mississippi Medical School. Robert Caskey intends to pursue an MD/PhD in tropical medicine, with a particular interest in the insect vectors of disease. James Goode is pursuing an MS degree in entomology at Mississippi State University, and Barrot Lambdin is enrolled in the Global Public Health program at Emory University.

Other Biological Research in Progress at the Reserve—The literature on the biology of the Yucatán is sparse. Most of it is in Spanish, and much is out of print. For the Reserve, the most pressing need is to determine what plants and animals live there. This is where we intend to concentrate our efforts for the next several years. Kaxil Kiuic has recently received funding from the *Consejo Nacional Forestal* (National Forest Council), a conservation agency of the Mexican government, to support baseline biological and archaeological studies necessary to officially designate the Moyers Reserve as an "*Área Natural Protegida*" (natural protected area). These studies will be carried out mainly by Mexican biologists and archaeologists with assistance from scientists already working in the area.

Two additional biological studies are already in progress at the Moyers Reserve: a systematic floristic survey has been initiated by Dr. John Hayden of the University of Richmond, and a herpetological inventory by Sr. César Gonzalez Martínez of Universidad Autónoma de Yucatán, which will be the basis of his Master's thesis. Principle investigators wishing to initiate biological research at the Helen Moyers BioCultural Reserve should contact Dr. Sarah Armstrong, Director of Biological Research for the Reserve, at the address above.

ACKNOWLEDGMENTS

We would like to thank our colleagues from the Universidád de Yucatán, Hugo Delfín, Vicki Meléndez, and Sergio Magaña, who helped us obtain supplies we could not bring in, shipped specimens, and worked with us several days in the field. We also thank James Callaghan, Director of Kaxil Kiuic, for assistance in making arrangements with the *Fundación Cultural Yucatán*.

The three papers that follow are the work of three of our students.

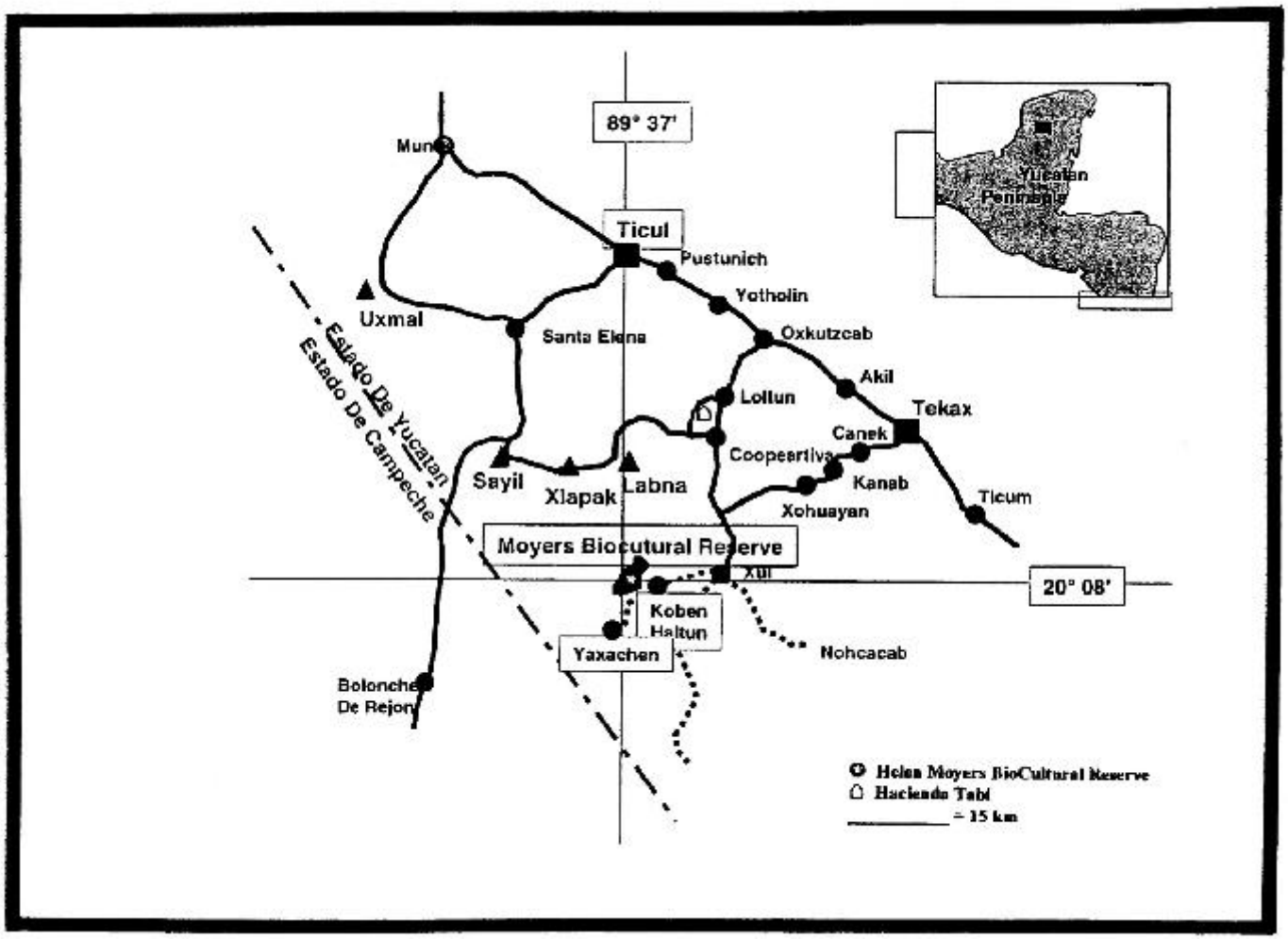

Figure 1. Location of Moyers Reserve and Hacienda Tabí. Map courtesy of Stan Galicki.

Evaluating Diversity: A Baseline Study Comparing the Diversity of the Order Diptera in Two Distinct Sites in the Yucatan Peninsula of Mexico

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A baseline study of the insect order Diptera (flies) was conducted in the Yucatan Peninsula of Mexico (Latitude: 20.0 N Longitude: 90.0 W) in which diversity was compared between two distinct sites: (1) the land immediately surrounding a former sugar cane plantation associated with the Hacienda Tabí (maintained by Fundación Cultural de Yucatán) and (2) the undisturbed dry tropical forest at the Helen Moyers Biological Reserve located at Kiuic (maintained by Millsaps College). It was hypothesized that a richer diversity would be present at the Kiuic site, which is relatively undisturbed, compared to the Tabí site. The following 17 Dipteran families were recorded for both sites: Tabanidae, Stratiomyidae, Asilidae, Culicidae, Mycetophilidae, Tachinidae, Muscidae, Tipulidae, Anthomyiidae, Bombyliidae, Tanypezidae, Syrphidae, Sciaridae, Pipunculidae, Chironomidae, Dolichopodidae, and Conopidae. The Kiuic site also reported 6 additional families: Phoridae, Heleomyzidae, Bibionidae, Scatopsidae, Scenopinidae, and Mydidae. The Tabí site, however, yielded eight additional families: Sarcophagidae, Ropalomeridae, Drosophilidae, Therevidae, Ceratopogonidae, Sciomyzidae, Calliphoridae, and Platystomatidae. Since many of the families individual to the Tabí site are common, these findings were interpreted not to indicate a significant difference in diversity between the two sites. For more conclusive data, more work must be done in the future, both in the identification of these insects to species, and in the studying of specific families.

This paper is a report of a baseline study conducted on the Order Diptera (flies), which was conducted during the early part of the rainy season in the dry tropical forest of the Yucatan Peninsula, an area which is largely biologically unexplored. In addition to establishing a baseline measure of diversity for the Dipterans in this area, an attempt was made to compare the diversity between two distinct sites within the dry tropical forest ecosystem there: (1) the relatively undisturbed forest area of the Helen Moyers Reserve at Kiuic and (2) the land on and surrounding a former sugar cane plantation and current citrus grove at Tabí, which for our purposes was considered to be disturbed, especially when compared to the Kiuic site. Both sites contained approximately 3,500 square acres of land and were separated by a linear distance of 19.7 km.

Dry tropical forests, such as the forest at Kiuic, are the most endangered type of tropical forest and are therefore the most endangered ecosystem type (Janzen, 1988). Essentially, it is the existence of a dry season that makes dry tropical forests so vulnerable. It is during this season that slash-and-burn farming and other destructive and ecologically disturbing human activities can have their greatest effect. Mexico itself is a country very rich in biodiversity, ranking third in overall biodiversity despite its being only the 14th largest nation in the world; over 30,000 plant species, 1,000 bird species, 449 mammalian species, and some hundred thousand different species of insects are found within Mexico (Ramamoorthy et al., 1993). The Order Diptera was chosen as the focus of this research for two reasons: (1) the inherent diversity within the order Diptera, especially in the tropics, and (2) the economic and medical importance of the Order Diptera, particularly in the tropics where they are involved as the vectors or cause of many important diseases of humans, plants, and livestock. Both of the above reasons justifying this research are compounded in importance by many magnitudes by the fact that the particular area of the Yucatan Peninsula that is the focus of this research is largely biologically unexplored and is some of the last remnants of relatively undisturbed dry tropical forest on the planet. On all levels, ecological, economical, and medical, research such as

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this is necessary for the future of studies in this area, and for understanding the overall effect this area and its diversity have on life on this planet as we know it.

METHODS AND MATERIALS

Standard entomological trapping techniques and taxonomic keys were used to capture and identify all fly specimens. Trapping techniques included: sweep nets, malaise traps, yellow pan traps, and black lighting, each of which was individually beneficial.

Experimental Design of the Study—Since the primary focus of this research was the establishment of a baseline level of diversity for the order Diptera in the Yucatan Peninsula, and the secondary focus was the comparison of two distinct sites, the experimental design of this research contains elements of both consistency and spontaneity depending on the nature of the capturing technique. Although it would have been desirable to maintain complete consistency between the two sites, this was found to be an unrealistic possibility due to both the time constraint of the study as well as a lack of specific knowledge about the two areas. Collecting began on the 12th of June and was continued for 9 days. It must also be noted that this collection time coincided with the beginning of the rainy season. The average amount of rain (cm/day) collected at the two sites over the period of the study is documented in Table 1. The average temperature range for the area per day was 22.36–32.08°C.

Table 1. Average rainfall as study sites.

	Average Rainfall (cm/day)
Kiuic	2.12 (range 0.254–5.46)
Tabí	2.77 (range 0.254–6.98)

Sweep Nets—Sweep netting was implemented freely and without any particular experimental design. An estimated 1% of each site was covered by the combined efforts of our research team. Two specific sweep nets were used in this study: (1) a round cloth net with a 15" diameter and 2.5' handle and (2) a diamond-shaped net, made of mesh, with a 4.5' handle, and detachable bottom. This second net was the primary net used because of efficiency in capturing and transferring of flies.

Malaise Traps—Since it was predicted that Malaise traps would be the most beneficial in capturing flies, much attention was given to choosing sites for these traps. Sites were chosen in both the Kiuic and Tabí areas and an attempt was made to vary both the vegetation and amount of light from site to site (Tables 2 and 3). Since the primary goal of this research was establishment of a baseline measure of diversity, and because it was hypothesized that Kiuic would be richer in insect diversity than Tabi, the odd Malaise trap was set up at Kiuic.

Yellow Pan Traps—Two to four yellow pan traps were placed in the immediate area surrounding each Malaise trap.

Black Light—Due to the amount of time required to set up this apparatus, it was only used once at each the Tabí and Kiuic sites. Both the Tabí and Kiuic sites were characterized by a medium amount of both understory and groundcover and minimal canopy. The Kiuic site, in addition, was close to a sinkhole filled with water and it was hoped that this would attract a different variety of insects. No serious attempt was made to capture dipterans using the black light at the Kiuic site, however, because of the poor result obtained at the Tabí site where the black light was used first.

Identification—The two taxonomic keys used in this research were the primary key found in Borror et al. (1992) and the keys specific to the Diptera found in McAlpine (1983). Because only Volume 2 of McAlpine was available at the time of the research and because of time constraints, these keys were not implemented as fully as possible. However all specimens were successfully keyed to family and some were keyed to genus.

RESULTS

A total of 31 different families (Table 3) were reported from the two sites. Seventeen of these were common to both the Kiuic and the Tabí areas: Tabanidae, Stratiomyidae, Asilidae, Culicidae, Mycetophilidae, Tachinidae, Muscidae, Tipulidae, Anthomyiidae, Bombyliidae, Tanypezidae, Syrphidae, Sciaridae, Pipunculidae, Chironomidae, Dolichopodidae, and Conopidae. Six additional families were found at the Kiuic site: Phoridae, Heleomyzidae, Bibionidae, Scatopsidae, Scenopinidae, and Mydidae. Eight families were found at Tabí, but not at Kiuic: Sarcophagidae, Ropalomeridae, Drosophilidae, Therevidae, Ceratopogonidae, Sciomyzidae, Calliphoridae, and Platystomatidae. A total of 245 dipterans were catalogued, 158 from Kiuic and 87 from Tabí. In addition, the high abundance, as

determined from the Malaise traps, of the families, Tabanidae, Asilidae, Stratiomyiidae, Syrphidae, and Tachinidae deserves mention here.

Table 2. Description of malaise trap habitats.

Malaise Trap	Location	Habitat Description
Malaise trap K1	Kiuic	Heavy canopy, heavy ground cover, within beam of sunlight
Malaise trap K2	Kiuic	Minimal canopy, heavy understory, minimal groundcover
Malaise trap K3	Kiuic	Open area near path with little overall vegetation
Malaise trap T1	Tabí	Heavy ground cover and understory, minimal canopy, within beam of sunlight
Malaise trap T2	Tabí	Heavy ground cover and understory, medium canopy

Table 3. Dipteran families catalogued from study sites.

Present at Kiuic	Bibionidae, Heleomyzidae, Mydidae, Phoridae, Scatopsidae, Scenopinidae
Present at Tabí	Calliphoridae, Ceratopogonidae, Drosophilidae, Platystomatidae, Ropalomeridae, Sarcophagidae, Sciomyzidae, Threvidae
Present at both sites	Anthomyiidae, Asilidae, Bombyliidae, Chironomidae, Conopidae, Culicidae, Dolichopodidae, Muscidae, Mycetophilidae, Pipunculidae, Sciaridae, Stratiomyidae, Syrphidae, Tabanidae, Tachinidae, Tanypezidae, Tipulidae

DISCUSSION

Capturing specimens of 31 different Dipteran families is certainly indicative of the high overall level of biological diversity present in this area, especially considering that this research took place over nine days during the beginning of the rainy season and was limited to only a small fraction (nearing 1%) of the land available to research. Essentially, this work has only just begun. Therefore, the main value of this research lies in its applicability to future studies. Future ecological research in the study areas of Kiuic and Tabí as well as the Yucatan Peninsula at large will not only be able to rely upon the baseline level of diversity established by this research, but will also be able to focus specifically upon the order Diptera.

In my attempt to compare diversity between the disturbed site of Tabí and the undisturbed site of Kiuic it was expected that diversity of the undisturbed forest site would be greater. This expectation, though not supported by these results, fulfilled by this research, is backed thoroughly by other research comparing disturbed and pristine areas (Krijger and Sevenster, 2001; Okwakol, 2000; Andersen et al., 2001). In this study there were two additional families unique to the disturbed Tabí site (8 total) when compared to those of the Kiuic site (6 total), but this can be interpreted as inconclusive for two reasons. First, all of the eight families that were unique to the Tabí site, with one exception, represent families easily obtained in this area, and secondly, there were other factors at the Tabí site contributing these results.

The families of Phoridae, Heleomyzidae, Bibionidae, Scatopsidae, Scenopinidae, and Mydidae which were found at the Kiuic site, are fairly general, as are the families of Sarcophagidae, Drosophilidae, Therevidae, Ceratopogonidae, Sciomyzidae, and Calliphoridae which were found within the Tabí site. The family of Ropalomeridae, represented by one specimen at the Tabí site, does, however, represent the rarest fly within the catalogue that resulted from this research. To designate the Tabí site as more diverse because of one specimen however, would certainly be premature.

The family Drosophilidae may not be the most common of all fly families, but members of this family can be easily found anywhere around rotting and decaying fruit. Therefore, presence of this family at Tabí, which is surrounded by citrus groves, is not surprising. Since no Malaise trap was set up at Kiuic with a fruit-bearing tree within view, it is not very surprising that this family was not represented at Kiuic. Future efforts should be made however, by such methods such as baiting a Malaise trap with fruit, to determine whether this family is present within the Kiuic site.

The absence of the families Calliphoridae and Sarcophagidae at the Kiuic site and their presence at the Tabí site were, most likely, the results of the immediate environments in which the Malaise traps were set and most sweep netting occurred. As mentioned above, the Tabí site is currently surrounded by many citrus groves. In addition, this, the family maintaining that maintains the hacienda on the property has livestock (goats, chickens, pigs) as well as domesticated dogs. The Dipteran families of Calliphoridae and Sarcophagidae would be expected to be more prevalent in an area where humans and livestock live. Calliphoridiae flies, more commonly known as blowflies or greenbottle and bluebottle flies, are particularly attracted to livestock and oviposit on fresh and cooked meat, and dairy products. Many are also attracted to excrement and are therefore of medical importance (McAlpine, 1983). For example, dysentery is often associated with high blow fly populations (Borror et al., 1992). The Sarcophagidae flies, are more commonly known as flesh flies, but this is partly a misnomer because only the larval stages of some of these flies are actually scavengers of decaying animals or parasitic on vertebrates. Most larvae of this family are instead parasitic on other insects, particularly Hymenopterans (Borror et al., 1992). Adult flesh flies feed largely on sap and nectar and do not feed on flesh at all. Members of both of these fly families, but especially those of the Calliphoridae, may be involved in myiasis, the parasitic infection of humans and animals by fly larvae. In conclusion, both of these families are common, but would be expected more in an area with humans and other animals nearby. It is encouraged however, that future research, in addition to focusing on the abundance of flies from the Tabanidae, Asilidae, Stratiomyiidae, Syrphidae, and Tachinidae families, also focus on positively identifying Calliphoridae and Sarcophagidae flies at the Kiuic site. Essentially, the complete absence of Calliphoridae and Sarcophagidae at the Kiuic site would be indicative of definite ecological disturbance, and purposeful efforts, such as traps baited with carrion, dung, or other material, should be used in retrieving these two families from this site.

In conclusion, the true value of this research lies

in its applicability to future research efforts. Possibilities of such research are seemingly endless. First, since this research established a baseline for dipteran diversity, future efforts may be focused on monitoring diversity on a yearly basis, as well as collecting data for the entirety of both the dry and rainy seasons. Second, many specific research opportunities are particularly pressing, such as assessing abundance or absence of certain families within these study areas. This research can also be the foundation of many general ecological studies in the future. Finally, since many families were present, or at least, known to be present, which are involved in disease transmission, it is personally desired that future research be directed toward medical entomology and tropical medicine. Though results of this study were inconclusive in showing that the undisturbed tropical forest area at Kiuic had a higher diversity than the disturbed land surrounding the Hacienda Tabí, it fulfilled its purpose in establishing a baseline level of diversity for the insect order Diptera. Such research may lead to the improved classification of the organisms of this area, preservation of these areas through habitat management, and increasing our understanding of the concepts behind biodiversity.

I suggest that such future studies begin by focusing on the abundance of the Dipteran families of Tabanidae, Asilidae, Stratiomyiidae, Syrphidae, and Tachinidae and the ecological problems that these abundances might indicate. Such abundances could indicate declining levels of overall plant and insect diversity (Haddad et al., 2001). It must be stressed however that this is only a possibility since there is no prior research containing diversity levels with which to compare these results. Furthermore, since this and the research of my colleagues who studied the Coleoptera and Hymenoptera, are the first established baselines of diversity for this area, the ecological monitoring of this area must begin now.

ACKNOWLEDGMENTS

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A List of Coleopteran Families Found in Disturbed and Undisturbed Areas in Yucatan, Mexico

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Families of the order Coleoptera found in two areas of Yucatán, Mexico were listed in an effort to establish a baseline for coleopteran diversity and to determine if unique families could be found in discrete areas. One area was undisturbed dry, tropical forest, and the other was an agricultural plantation; they were 19.7 km apart in linear distance. Insects were captured via sweep nets, Malaise traps, pit-fall traps, black lighting, and Berlese funnels. Insects were killed in Nalgene vials containing cedar chips and a sufficient amount of ethyl acetate. A total of 189 insects were collected and identified over a two-week period representing 23 different families. Of the families recorded, 15 were common to both areas. Only 2 families were unique to the agricultural area, and 6 families were unique to the undisturbed forest area. Based on the insects collected, there was not a marked difference in the families that were found in each area. The unique families could be a result of a collection bias in each area.

Although much is known about the physiology and functioning of beetles in general, very little taxonomic information is known about beetles in the Yucatan. Literature searches yielded very little information about general beetle populations in Yucatan; the articles primarily dealt with particular species and their interactions with the flora of the area. The species level data are too limited for the scope of this project.

The purpose of this project was to start listing the families of beetles present in the Yucatan in order to establish a baseline list of beetle families in that area. This project can serve as a guide for further research in the Yucatan.

Also, an effort was made to determine if there was any difference between which families could be found in the undisturbed versus disturbed areas used as the collecting sites.

MATERIALS AND METHODS

***Specimen Collecting Environment*—**The two areas selected for collection were both highly vegetated but markedly different. The Helen Moyers Reserve at Kiuic, Yucatan, Mexico has been relatively undisturbed for a few hundred years. The only type of disturbances encountered were the trails around the area. The Hacienda San Juan Bautista at Tabí, Yucatan, Mexico is a highly agricultural area with many mango and orange groves in the immediate area. Also, many remains of buildings from an abandoned sugarcane plantation dotted the collection area. These areas were roughly 19.7 km apart in linear distance.

Insects were collected daily over a two-week period during the early rainy season. The majority of insects were collected during daylight hours and in areas not far from established trails. Only the understory served as the prime place for collecting; no canopy collecting was performed. Collection at Kiuic was done typically from 8:00 AM until 1:00 PM, 5 hours, in order to avoid the heat of the day and the daily rainstorms. After returning to Tabí, collection resumed there from 4:00 PM until 7:00 PM, 3 hours. The remaining time was spent keying out and pinning specimens.

***Specimen Gathering*—**For collecting specimens along trails and among bushes the sweep net was the most efficient tool because it was able to cover a large area in each sweep. Contents collected were sorted quickly after sweeping to prevent specimen loss and were deposited into collecting vials containing ethyl acetate.

For collecting at night, light sources were utilized because of their attractiveness to insects. Aside from using the incandescent lights in open-air passageways at the laboratory, a black-light system was used for collecting in the densely vegetated areas. A 15-

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watt black light powered by a 12-volt DC lawnmower battery was hung behind a white cotton sheet. Insects were attracted to the light and landed on the sheet. Specimens were quickly picked off the sheet by hand and placed in collecting vials.

For more passive collecting, pit fall traps were put in place. Only a limited number of traps were available in the field and had to be placed with much discretion. The traps consisted of 2 empty 310.5-mL soup cans buried level to the ground. Between the 2 cans, a stick or plank served as a barrier to direct the insects to the buried cans. The cans were baited with caterpillar dung, fruit, and frog corpses. Once a day over the period of a week, cans were checked and insects were collected from the traps and placed in the collecting vials.

Leaf-litter sorting was performed with two tools. A sifter made of two 30.48-cm metal rings, 1-cm hardware cloth, and rip-stop nylon sorted leaf materials in the field. In the laboratory, the sifted material was emptied into a collapsible Berlese funnel and allowed to dry. At the base of the funnel, a small plastic bag with 2 mL of ethyl alcohol was used to collect insects as they emerged from the desiccated leaf-litter. To provide desiccation, a 60-watt light bulb was hung over the top of the canvas bag and allowed to burn continuously.

Another passive collection method used a Malaise trap. Three traps were placed at Kiuic, and two traps were placed at Tabí. Traps were placed in areas of various growth densities ranging from dense forest to almost open field. These locations were chosen in an effort to collect as many different insects from different habitats as possible. These traps were checked every day for a two-week period.

***Specimen Killing and Pinning*—**After insect specimens were caught, they were immediately placed in 30 mL, 60 mL, or 118 mL wide-mouth Nalgene vials. Inside the vials were cedar chips, typically found in rabbit bedding, soaked in ethyl acetate, the killing agent. Potassium cyanide was not used because it causes many insect specimens to become brittle. Nalgene vials were used because they are shatterproof and are not affected by chemical contact.

Wooden pinning blocks and Elefant insect pins were used for mounting. Pins in sizes 0,1, 2, and 4 were used to accommodate the range of specimen sizes. The pinned specimens were placed in thick, hinged cardboard boxes with a layer of Styrofoam in the bottom for holding the pins. Small amounts of para-dichlorobenzene were used to protect the collections from infestation by dermestids and other harmful insects.

***Specimen Identification*—**Insects were identified using a Bausch & Lomb 0.7x–3x dissecting microscope with an incandescent light source. All specimens were identified using the Coleoptera key by Borror et al. (1989). Some specimens were cross-checked using a computer program developed by Lawrence et al. (2000). Measurements necessary for identification were made with a standard metric ruler and metric calipers.

RESULTS

Although this study is qualitative in design, Table 1 shows that a total of 189 insects representing 23 different families was catalogued over a two-week period. Of the families recorded, 15 families were common to both areas. Only 2 families were unique to Tabí, and 6 families were unique to Kiuic.

DISCUSSION

The results (Table 1) indicate that there are a few families that were unique to each collecting area. Although unique families were found, none of them were rare. It is likely that even the most novice of collectors could have found them all if the proper parameters were established. Perhaps the most likely reason for finding unique families in each area lies in a collecting bias. Collecting in each area, although performed every day, was done in the same areas around the Malaise traps and the trails leading to the traps. If the traps were moved and different trails were traveled, there might be a mirror-image trend in the families collected at each site. Perhaps if truly equal time were given to each site, more of the same families would have been collected. With so many biases built into this project, it is difficult to accurately compare the diversity between the two sites.

Table 1. Families collected and location. Families were collected over a two-week period.

Family	Number of Specimens	Location Collected
Alleculidae	4	Kiuic
Bostrichidae	1	Tabí
Carabidae	10	Kiuic & Tabí
Cerambycidae	12	Kiuic & Tabí
Chrysomelidae	26	Kiuic & Tabí
Cicindelidae	11	Kiuic & Tabí
Corylophidae	2	Kiuic & Tabí
Cucujidae	3	Tabí
Curculionidae	6	Kiuic & Tabí
Dytiscidae	2	Kiuic & Tabí
Elateridae	6	Kiuic & Tabí
Endomychidae	2	Kiuic
Histeridae	1	Kiuic
Hydrophilidae	5	Kiuic & Tabí
Lampyridae	8	Kiuic & Tabí
Lycidae	3	Kiuic
Nitidulidae	2	Kiuic
Passalidae	9	Kiuic & Tabí
Phalacridae	2	Kiuic
Phengodidae	5	Kiuic & Tabí
Scarabaeidae	40	Kiuic & Tabí
Tenebrionidae	17	Kiuic & Tabí
Trogossitidae	5	Kiuic & Tabí

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A Comparative Study of Hymenopteran Diversity between Kiuic Research Station and Hacienda Tabi in the Yucatan Peninsula of Mexico

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A survey of families within the order Hymenoptera was performed in two distinct locations in the Yucatan Peninsula of Mexico to determine if a correlation exists between ecological setting and overall family diversity. One site, Kiuic, was representative of a relatively undisturbed section of dry, tropical forest, while the other site, Hacienda Tabi, was characteristic of an agricultural setting. My hypothesis was that a higher diversity of hymenopteran families would be obtained at the relatively undisturbed setting of Kiuic when compared to the disturbed setting of Hacienda Tabi. Using sweep nets, Malaise traps, yellow pan traps and black lights, a total of 26 families of Hymenoptera were collected. The site at Hacienda Tabi yielded 16 families, and the location at Kiuic produced 23 families. The two research sites shared 14 of the same families of Hymenoptera. Two families collected at Hacienda Tabi were not found at Kiuic, and 10 families collected at Kiuic were not found at Hacienda Tabi. Results indicated that a slightly higher family diversity at the site of Kiuic Research Station compared to that at the Hacienda Tabi, but these results could not be confirmed.

Based upon current literature, little is known about diversity of the class Insecta in the Yucatan peninsula of Mexico. Within the class Insecta, the order Hymenoptera is of extreme importance in understanding biodiversity of the region. The diversity of hymenopterans can be an indicator of the condition of other taxa (LaSalle and Gould, 1993; Duelli and Obrist, 1998). For example, one of the major roles of this order of insects is parasitism and predation of other insects. In many of these parasitic groups, the ovipositor has been modified into a stinger which is used as a killing mechanism and/or as an organ of defense (Borror et al., 1989). Therefore, hymenopterans play a vital role in keeping populations of certain insect groups at a healthy level which could lead to greater diversity in the insect community. Also, some families of Hymenoptera are pollinators of flowering plants. In the pollinating groups, the labium and maxillae have been modified into a proboscis which aids in extracting nectar from flowers (Borror et al., 1989). While extracting nectar, these individuals also cross-pollinate the flower which leads to greater diversity and genetic variability within the plant community. With their role as parasites and pollinators, the diversity of hymenopterans is important for the health of the ecosystem.

The order Hymenoptera has many diverse methods of survival, behavior and interaction. Many of the families within this order exhibit eusociality while others are strictly solitary. Some hymenopterans undergo complete metamorphosis and often the larval stage is a grub-like or maggot-like larva. In many hymenopterans, sex is determined by whether or not an egg has been fertilized. Fertilized eggs yield females, while unfertilized eggs yield males (Borror et al., 1989). The different behaviors and survival tactics allow hymenopterans to utilize a wide range of habitats.

MATERIALS AND METHODS

Collections were made over a period of 9 days, using sweep nets, Malaise traps, yellow pan traps, and black lighting. Sweep nets were used to sweep through vegetation along trails. Two different shapes of nets were used in the collecting process. One type had a circular frame with a diameter of approximately sixteen inches, which was used along roadsides and in open areas. The other type of sweep net had a diamond-shaped frame with a width of approximately 22.86 centimeters and was used to sweep through dense vegetation. Specimens were transferred to a killing jar containing either ethanol or

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ethyl acetate. Most sweep net collecting was carried out between 0800 hours and 1300 hours CDT. In addition, periodic collections were made between 1600 hours and 2000 hours CDT.

Malaise traps were used to collect specimens that may not have been obtainable with sweep nets. A total of five Malaise traps were set up in various flyways and edge habitats throughout the collecting areas. Since there were five Malaise traps, three were set up at Kiuic Research Station and two were used at Hacienda Tabi. The collecting jar was filled with ethanol to allow for a wet collection. Specimens were collected from the Malaise traps once each day.

Two yellow pan traps were placed next to each Malaise trap. Each of the pans was filled with water and dishwashing detergent to act as a surfactant. The surfactant decreased the surface tension of the water, which allowed the insects to sink below the surface so that they would drown and not escape. Traps were checked and specimens collected from them daily.

Ultraviolet traps were also used to collect nocturnal families of Hymenoptera. A white sheet suspended between two trees was illuminated with ultraviolet light. Insects were collected by hand as they landed on the sheet, and transferred to a killing jar containing ethanol. The light was left in place for approximately one hour. Traps were set up one night at Kiuic Research Station for approximately sixty minutes and one night at Hacienda Tabi for the same interval of time.

Collections were processed in the field laboratory set up at Hacienda Tabi. Specimens were sorted into jars labeled with the date, time and place they were collected. The insects of a particular sample were pinned on a pinning block and identified to the family level using the dichotomous keys by Borror et al. (1989), Goulet and Houber (1993), and Rommoser and Stoffolano (1998). Specimens were catalogued and stored in pinning boxes containing para-dichlorobenzene to discourage infestation.

RESULTS

The results are indicated below in Table 1. A total of 26 families of hymenopterans were collected between the two different collection sites. The site at Hacienda Tabi yielded 16 families, while collections from Kiuic contained 23 families. The two research sites shared 14 of the same families of Hymenoptera. Two families collected at Hacienda Tabi were not found at Kiuic, and 10 families collected at Kiuic were not found at Hacienda Tabi.

DISCUSSION

As indicated in Table 1 fourteen families were common to both collection sites in the study. These families include Ichneumonidae, Ormyridae, Eucollidae, Bethyliidae, Dryinidae, Sphecidae, Halictidae, Apidae, Tiphiidae, Mutillidae, Bradynobaenidae, Pompilidae, Vespidae and Formicidae. The extensive overlap of families collected at the two locations could be a reflection of the broad habitat requirements of those families.

Ten families of the order Hymenoptera were collected at the relatively undisturbed dry tropical forest of Kiuic Research Station, but not at the more disturbed area of Hacienda Tabi: Evaniidae, Braconidae, Torymidae, Eucharitidae, Chalcididae, Diapriidae, Scelionidae, Colletidae, Andrenidae and Sapygidae. The presence of some families such as Torymidae, Diapriidae and Sapygidae at only the Kiuic collection site may be due to the relatively specific requirements of these families for survival. Members of the family Torymidae feed upon gall insects, mantid eggs and certain seeds, while the family Diapriidae are reliant upon certain groups of Dipterans, especially those that feed upon fungi. The family Sapygidae is limited to the family Megachilidae, the leaf-cutting bees, and wasps for a food source (Borror et al., 1989). In all three families, the specificity of food sources required for survival might be the reason why they appear in the biologically diverse region of Kiuic rather than the Hacienda Tabi. As for the other seven families—Evaniidae, Colletidae, Braconidae, Eucharitidae, Chalcididae, Scelionidae and Andrenidae—the requirements for survival are broader. Therefore, I would have expected to find them at Hacienda Tabi as well as Kiuic, but did not.

Two families of Hymenoptera were obtained at Hacienda Tabi that were not found at Kiuic Research Station: Xiphydriidae and Scoliidae. Specimens of the family Xiphydriidae were harvested via malaise traps, while those of the family Scoliidae were collected in sweep nets. A possible reason that the family Xiphydriidae was represented at Tabi and not at Kiuic is the abundance of deciduous trees associated with the surrounding fruit farms, which would provide a large amount of decaying wood necessary for the larvae of this family. The collection of a member of the family Scollidae at Tabi could be due to the large numbers of scarab beetles associated with human habitation, which would provide food for the

Scollidae (Borror et al., 1989). Since both decaying wood and scarab beetles are also found at Kiuic, these families may well be found there when collecting is extended.

The work reported here is a preliminary attempt to catalog the diversity of hymenoptera at the two locations. Future studies should be designed to ensure that collecting effort is equivalent at each site. Also, further taxonomic categorization may be necessary to make definitive conclusions in comparing the hymenoptera diversity of the two areas. Nevertheless, a great deal of research in the field of

Table 1. A comparison of hymenopteran families collected between Kiuic Research Station and Hacienda Tabi.

Families of Hymenoptera Collected	Collected at Hacienda Tabi	Collected at Kiuic Research Station	Number of Specimens Collected
Scoliidae	✓		1
Xiphydriidae	✓		1
Formicidae	✓	✓	30
Vespidae	✓	✓	20
Apidae	✓	✓	27
Ichneumonidae	✓	✓	31
Sphecidae	✓	✓	24
Dryinidae	✓	✓	4
Pompilidae	✓	✓	4
Bradynobaenidae	✓	✓	3
Tiphiidae	✓	✓	6
Halictidae	✓	✓	9
Eucollidae	✓	✓	4
Bethyliidae	✓	✓	3
Ormyridae	✓	✓	2
Mutillidae	✓	✓	6
Braconidae		✓	7
Colletidae		✓	2
Scelionidae		✓	2
Chalcididae		✓	2
Torymidae		✓	1
Diapriidae		✓	1
Eucharitidae		✓	3
Evaniidae		✓	1
Andrenidae		✓	1
Sapygidae		✓	1

entomology is waiting to be explored on the Kiuic Research Station in the Yucatan Peninsula of Mexico.

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Geology of the Walnut Miss.–Tenn. 7.5 Minute Topographic Quadrangle

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Stratigraphic units of Cretaceous, Tertiary and Quaternary age crop out within the geographic bounds of the Walnut Miss.–Tenn. 7.5 minute quadrangle. The Cretaceous unit cropping out in the map area consists of the late Cretaceous Owl Creek Formation with the Cretaceous-Tertiary boundary forming the upper contact. The Tertiary section consists of the basal Clayton Formation, Porters Creek Formation, and the Naheola Formation of the Midway Group with the Meridian Sand of the Claiborne Group stratigraphically overstepping the older Midway formations. Significant flood plain deposits associated with the existing fluvial systems comprise the sediments of the Quaternary. The outcrop belts are generally oriented in a northerly direction and dip toward the west. Local structure has influenced both the dip of the units and the outcrop patterns. The major structural feature is the Muddy Creek Fault Zone located along the trend of Muddy Creek. The small anticlinal structure just west of Walnut, Mississippi, is likely associated with the adjacent Muddy Creek Fault Zone.

This investigation is part of a joint effort by the Mississippi Mineral Resources Institute (MMRI) and the University of Mississippi's Department of Geology and Geological Engineering to map Cretaceous and Tertiary stratigraphic units in northern Mississippi. The purpose of the mapping effort is to provide a source of updated information to the public, the mining industry and local planning commissions, and to aid regional economic development. The mapping also fulfills an educational purpose by providing first-hand knowledge of field stratigraphy and mapping techniques to graduate students.

The mapping of the geological units was accomplished using U.S. Geological Survey topographic base maps with a relative fraction scale of 1:24,000. Earlier geologic mapping, such as that done by Conant and McCutcheon (1941), did not have access to topographic maps and so the use of the topographic base is a significant step to refining the outcrop patterns. More detailed geological maps also allow natural hazards, such as expansive clays, to be incorporated into regional planning and zoning.

Previous Geological Mapping—Tippah County was previously mapped by Conant and McCutcheon (1941) and the northern-most area adjoining the Mississippi–Tennessee line was mapped by E.E. Russell (E.E. Russell, oral communications, 2001), in the course of geological mapping for the State of Tennessee. Herrick and Rima (1968) also published a map including the northern-most edge of the quadrangle in a report on the Foraminifera from the Clayton Formation in Hardeman County, Tennessee. The adjacent Falkner and Chalybeate quadrangles (Mississippi) have been mapped by Swann (1997, 1999) and the adjoining Camp Hill and Whitten Town (Mississippi) quadrangles were mapped by Thompson (2000a, b). The surface geology of adjoining Benton County was reported by Lusk (1956).

Area of Study—The Walnut Quadrangle includes areas of northern Tippah County, Mississippi, and the southern extreme of Hardeman County, Tennessee (Fig. 1). The town of Walnut, the largest municipality in the study area, is located in the northern half of the quadrangle. The major transportation corridor is U.S. Highway 72, traversing the study area from east to west and passing through Walnut. The Holly Springs National Forest comprises much of the western third of the study area. Geological mapping was focused on the study area, but additional mapping was carried out in adjacent quadrangles to allow smooth transitions of contacts across map boundaries. The northward flowing Muddy Creek is the major fluvial component in the study area. Relief within the quadrangle is approximately 240 feet. The lowest elevations are along Muddy Creek and the highest are in the hilly terrain of the northwestern corner of the study area.

Surface Stratigraphy—This stratigraphic analysis supports and updates the general stratigraphic relationships described by Conant and McCutcheon (1941) and the geological mapping by Lusk (1956) in

adjoining Benton County, Mississippi. The MMRI-Martindale No. 1 stratigraphic test well (Fig. 2) was drilled in the northwestern quarter of the study area (sec.35, T1S, R3E) to aid in stratigraphic analysis. The well was cored to a total depth of 370 feet (112.5 m) and a suite of down-hole geophysical logs was obtained to aid between-well correlations. The stratigraphic units assigned to the core included the Cretaceous Ripley and Owl Creek Formations, the Tertiary Clayton, Porters Creek, Naheola Formations, and the Meridian Sand. The Ripley Formation, oldest unit recognized in the core, does not crop out in the study area. The remaining units crop out within the study area.

The Ripley Formation (Selma Group), in Missis sippi, is divided into several members with the Chiwapa Sandstone the youngest. The core between the depths of 269 feet (82 m) and 370 feet (112.8 m) was assigned to the Ripley Formation. A typical Chiwapa lithology of phosphatic, glauconitic and fossiliferous, interbedded sand, sandy limestone and calcareous sandstone was encountered between the depths of 306 feet (93 m) and 360 feet (109.4 m). It is interesting to note that the Chiwapa calcareous beds are approximately 40 feet (12.2 m) below the upper formational contact rather than comprising the upper-most Ripley section, its typical stratigraphic position. The top of the Chiwapa (i.e., the Ripley–Owl Creek formational contact) is unconformable and the basal Owl Creek sand often contains the trace fossil *Ophiomorpha* sp. (fossil burrow of the ghost shrimp, *Callianassa major*).

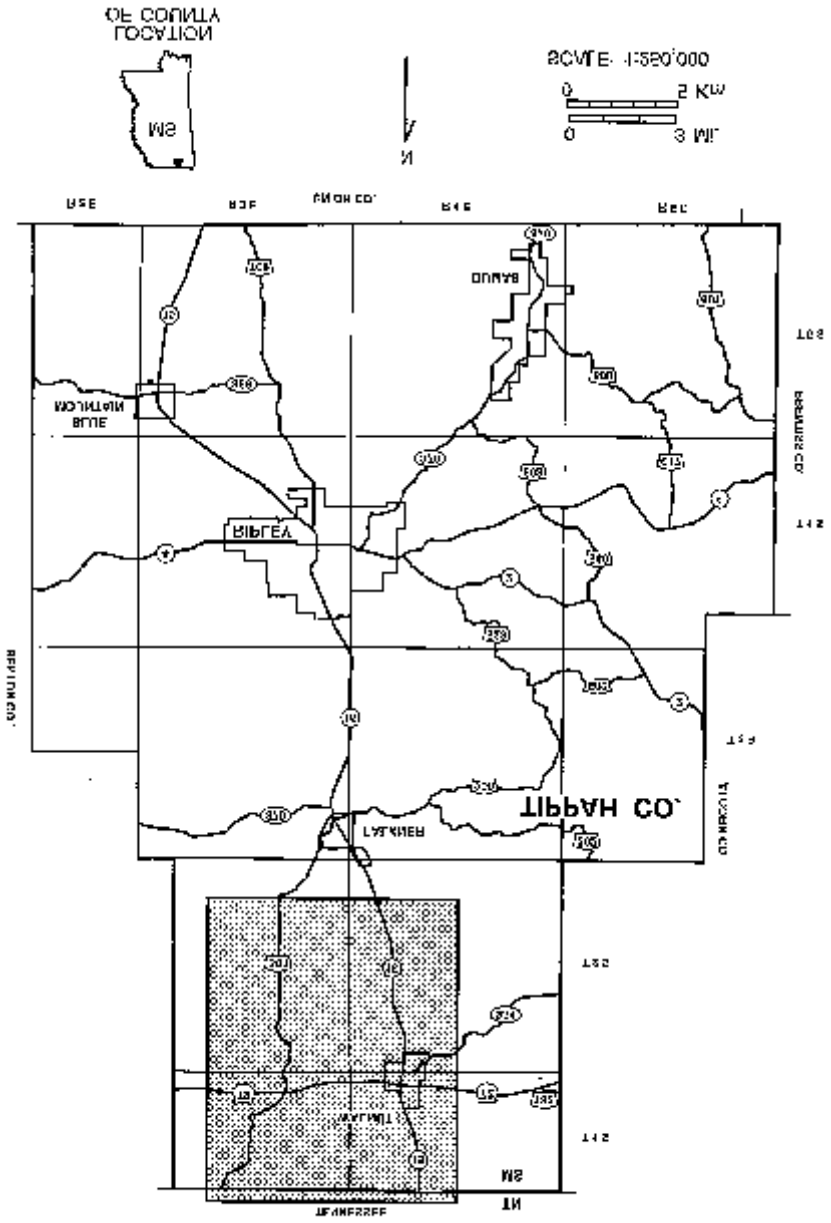


Figure 1. Geographic location of the Walnut, Miss.–Tenn. topographic quadrangle (shaded area) with selected cultural features.

The oldest stratigraphic unit cropping out within the quadrangle is the Cretaceous Owl Creek Formation, the youngest formation of the Selma Group (Fig. 3). The Owl Creek comprises the top of the Cretaceous section with the Cretaceous–Tertiary boundary as its upper contact; a basal sand marks its lower, unconformable contact with the Ripley Formation. The Owl Creek is poorly represented in the study area with only very limited outcrops along the eastern valley wall of Muddy Creek and highly weathered exposures along the eastern edge of the study area. The Owl Creek typically consists of dark- to medium-gray, silty clay with a locally abundant molluscan fauna. Carbonaceous plant fragments are typically present near the upper contact. Fifty-three feet (16.5 m) of core (216 feet [65.7 m] to 269 feet [82 m] in depth) in the MMRI-Martindale test well were assigned to the Owl Creek Formation and consist of medium-gray, silty clay

to friable, glauconitic clay. Molluscan fossils are sparse. The base of the unit consist of a four-foot, medium- to fine-grained, glauconitic sand. The upper contact is typically sharp in outcrop when defined by the basal, fine-grained to gravelly sand of the Clayton Formation. In the MMRI-Martindale, No. 1 core, the Clayton-Owl Creek contact was marked by a sharp change from a dark gray, silty, sandy clay with carbonized plant debris of the Owl Creek to the fine-grained, glauconitic sands of the basal Clayton Formation.

The Clayton Formation is the oldest formation of the Paleocene Midway Group. MacNeil (1946) proposed the Chalybeate Limestone Member to include the Clayton facies containing sand and limestone verses the chalk facies further south in its outcrop belt. The entire formation in the study area is assigned to the Chalybeate Limestone Member.

The Clayton's primary outcrop belt coincides, for most part, with the Muddy Creek valley walls. North of Highway 72 the Clayton crops out on both sides of the Muddy Creek valley, but south of this point it is largely confined to the eastern valley wall. Increasing displacement along the Muddy Creek Fault Zone is interpreted as being a major controlling factor influencing the width and orientation of the Clayton outcrop pattern.

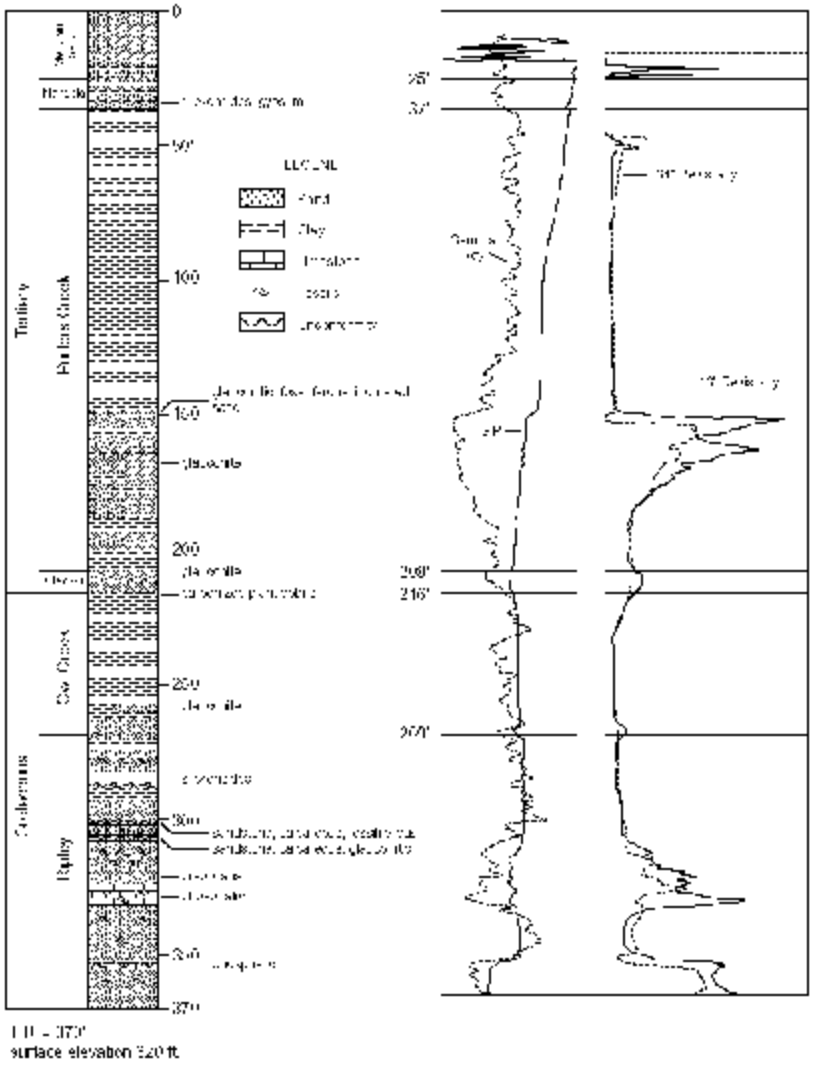
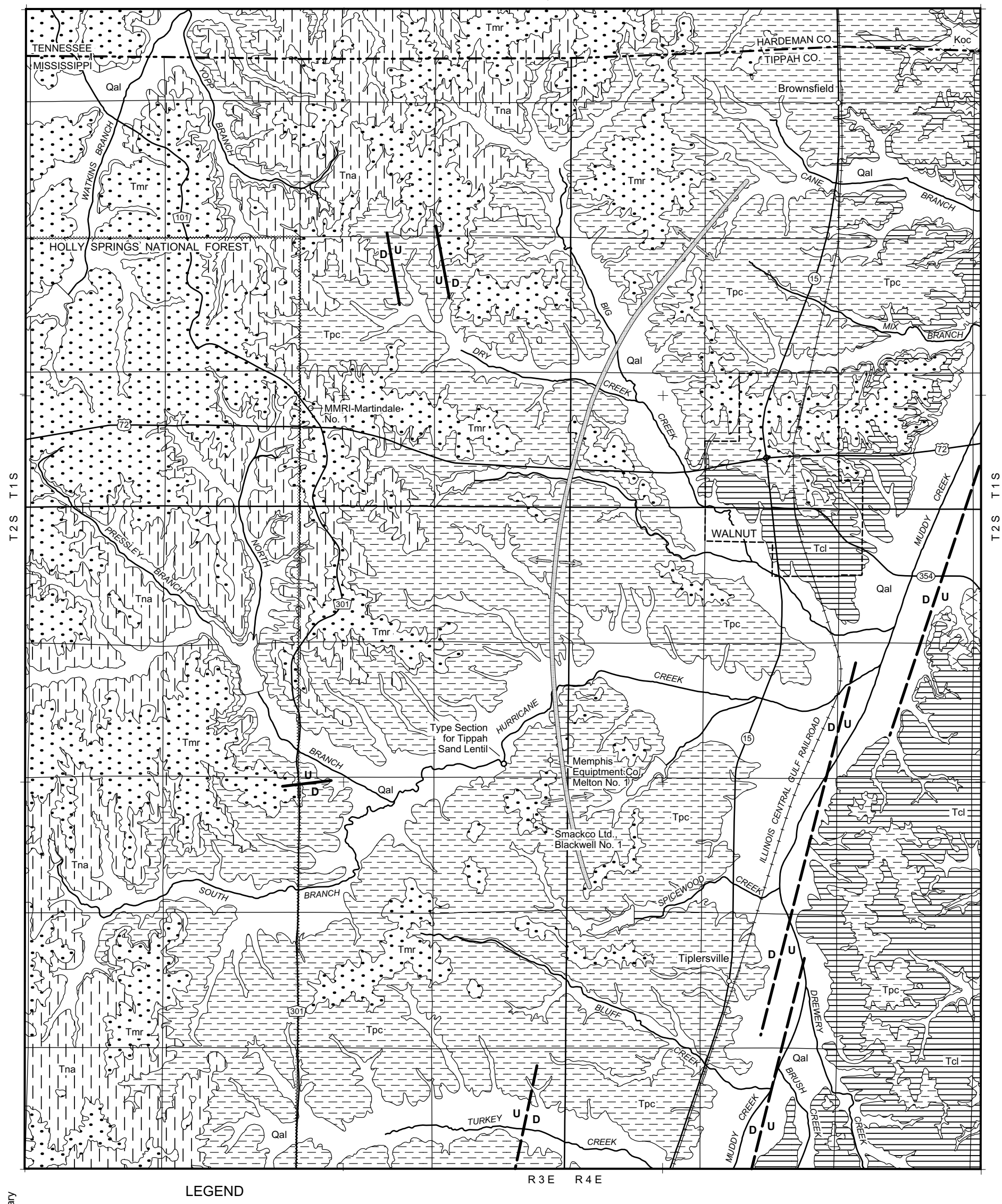


Figure 2. Stratigraphic assignments derived from core samples and geophysical log from the MMRI-Martindale No.1 stratigraphic test well.

Lithologically, the Clayton typically consists of a thin basal sand or gravelly sand, a fossiliferous limestone unit of varying thickness, and a thick unit of fine-grained, glauconitic sand which makes up the majority of the formation (Conant and McCutheon, 1941; Swann, 1999). The basal sand is typically less than one foot (0.3 m) in thickness and if the gravel component is missing, careful field work is required to distinguish it from the sand-enriched facies of the Cretaceous Owl Creek Formation. The limestone section was particularly well exposed during road construction associated with the expansion of Highway 72. In the western valley wall of Muddy Creek (eastern ½, sec. 33, T1S, R4E) the limestone required ripping to construct the road grade. This section consisted of a light gray to light greenish-gray, fossiliferous, sparry limestone and an overlying bed of sparsely fossiliferous, glauconitic, fine-grained sand. Although there were several molluscan taxa present as molds and casts in the limestone section, only *Ostrea pulaskensis* was identifiable. The fossils in the sand section were molds and casts and could only be identified as bivalves. The glauconitic, fine-grained sands comprise most of the Clayton section and are the most common lithology in exposures.



LEGEND

Quaternary

Qal — Sand, silt, clay: flood plain deposits associated with existing fluvial system

Tertiary

Tmr — **Meridian Sand**
Sand: medium- to coarse-grained, cross-bedded, minor clay beds, silicified wood locally common

Tna — **Naheola Formation**
Sand, clay, lignite: sand beds typically medium-grained and argillaceous, may be well sorted, may locally contain granules; clays are gray to yellowish-gray, thinly bedded to laminated; base is locally channeled and may contain angular clay boulders, often has a "mealy" texture

Tpc — **Porters Creek Formation**
Clay: micaceous, locally silty, massive to laminated, conchoidal to blocky fracture, spiculitic, sparse bivalve fossils; becomes sandy, glauconitic, bedded in lower part of section; becomes massive upon weathering

Tcl — **Clayton Formation; Chalybeate Member**
Sand: medium- to fine-grained, poorly bedded, minor clay beds, fossiliferous; at base is discontinuous limestone, glauconitic, phosphatic, fossiliferous; upper unit weathers to massive argillaceous sand; entire unit assigned to Chalybeate Member

Cretaceous

Koc — **Owl Creek Formation**
Clay, silt, sand: typically silty clay, sandy, very micaceous, fossiliferous; sand beds fine-grained, thin; unit often carbonaceous at top; weathers to sandy clay

Axis of anticlinal feature

Hydrocarbon well - dry hole

Unconformity

U/D — Fault: Approximately located; upthrown and downthrown blocks indicated by "U" and "D"

U/D — Fault: Measured location

MS N

0 1 Mi.

0 1 Km

SCALE; 1:48,000

Projection is Transverse Mercator

REGISTERED PROFESSIONAL GEOLOGIST
MS 0003
CHARLES T. SWANN

Geologic map of the Walnut, Miss.-Tenn., 7.5' Quadrangle

Geology by Charles T. Swann, R.P.G.
Mississippi Mineral Resources Institute
2003

Figure 3: Geologic map of the Walnut 7.5 minutetopographical quadrangle, with structural elements.

In weathered exposures, this upper Clayton sand is an argillaceous, massive clay, with a red color derived from the weathering of glauconite, and with sparse *Ophiomorpha* sp. In the MMRI-Martindale core, the Clayton was assigned 16 feet (4.9 m)of section i.e., from 208 feet (63.4 m) to 216 feet (65.9 m) in depth.

The Paleocene Porters Creek Formation (Midway Group) conformably overlies the Clayton Formation. The Porters Creek forms the most extensive outcrop belt of all the mapped units and is located in a northerly trending belt near the center of the study area. In this study, the Porters Creek was subdivided into two sections, a sandy lower section (Tippah Sand Lentil and equivalent sections) and the typical clay upper section with a thin bed of indurated claystone marking this interformational boundary. Placing the indurated claystone within the Porters Creek Formation varies with Conant and McCutcheon (1941), who used it as the lower Porters Creek formational boundary. Their decision to use the claystone (which they identified as a sandstone) is unfortunate, because applying it as the formational boundary would place the Tippah Sand Lentil in the Clayton Formation. Conant and McCutcheon describe a typical exposure of the claystone bed northeast of Tipplersville (their exposure number 2, page 33) which lies within the study area. This claystone bed is clearly within the lower Porters Creek section with the massive, glauconitic sands of the Clayton well below the claystone. The lower lithologic units of the Porters Creek are best exposed in the northern half of the study area and the upper clay section is best exposed in the southern half. A total of 171 feet (52 m) (from a depth of 208 feet [63.4 m] to 37 feet [11.3 m]) of section was assigned to the Porters Creek Formation in the MMRI-Martindale No.1 stratigraphic test well.

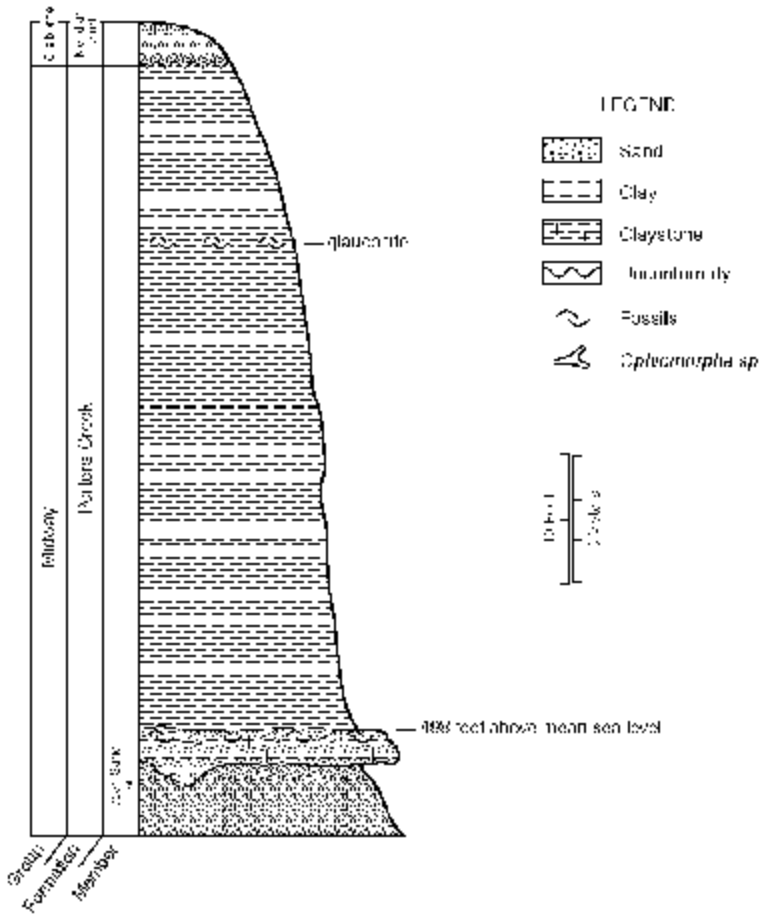


Figure 4. Porters Creek and Meridian Sand section from road cut exposures in the southern valley wall of Hurricane Creek (sec. 12, T2S, R3E). These exposures are considered the type section for the Tippah Sand Lentil.

The Clayton-Porters Creek contact is conformable and so the two lithologies are intercalated. The fine-grained, glauconitic sands of the upper Clayton section become more argillaceous and thin clay beds become common in the transition zone. In this mapping, the fine-grained sands have been retained in the Clayton and the interbedded sand and clay section was assigned to the lower Porters Creek Formation. The base of the lowest clay bed in the transition zone was chosen as the contact for mapping purposes.

The lower Porters Creek section is developed more fully in the study area than any other area in Mississippi. A total of 59 feet (18 m) (from depths of 208 feet [63.4 m] to 149 feet [45.4 m]) was assigned to the lower Porters Creek section in the MMRI-Martindale No.1 test well. The lower Porters Creek consists of a series of fine-grained sands, clay beds and indurated claystones representing beach to nearshore marine conditions. The sand beds appear to represent very near shore barrier bar to beach depositional environments. The Tippah Sand Lentil is a formally named concentration of sand within the lower Porters Creek section. The upper 15 feet (4.6 m) of the Tippah

Sand at the type section (SE ¼, sec. 12, T2S, R3E) are exposed in road cuts on the southern valley wall of Hurricane Creek. The Tippah Sand lithology here consists of very well sorted, micaceous, fine-grained sand containing laminations and *Ophiomorpha* sp. (Fig. 4) in addition to the upper Porters Creek clays and a thin section of basal Meridian Sand. Reineck and Singh (1975) would assign facies such as the Tippah Sand at the type section to middle shoreface depositional environments. Up the dip, the equivalent lower Porters Creek section (NW ¼, sec. 21, T2S, R4E) is more argillaceous and contains wavy bedding and abundant burrows (Fig. 4). This facies suggests more near shore, intertidal depositional environments (Reineck and Singh, 1975) such as a coastal salt marsh.

A thin claystone overlies the beach deposits and represents the base of the upper Porters Creek section. The claystone is of particular interest as it contains sparse, abraded bivalve fragments (*Venericardia* sp.) and represents the transgressional phase, flooding the near shore sediments of the lower Porters Creek. Above the claystone is a thick clay section typical of the lithology often associated with the Porters Creek Formation.

The typical clay lithology of the Porters Creek consists of medium to dark gray clay which breaks with a conchoidal fracture. This clay section comprises the majority of the Porters Creek section and is a section of economic interest. The clay section appears massive upon initial examination, but when dried, laminations and thin silty, micaceous partings are obvious. The laminations can be well developed locally, even to casual observation throughout the section. Fossils are sparse and typically poorly preserved. There are at least two glauconite-enriched zones that subdivide this clay section. The glauconitic zones, when weathered, are often marked by black concretions consisting of manganese and iron oxides, and quartz sand grains. The clay section may also contain small, isolated channel sands of local extent. The clays are also highly expansive and have been responsible for foundation problems in structures not properly constructed to accommodate the movement associated with clay expansion and contraction.

The clay section becomes increasingly silty near the upper contact with the Naheola Formation, but retains its medium to dark gray color, conchoidal fracture and laminations typical of the Porters Creek lithology. It should be pointed out that Thompson (2000a, b) correlates the Matthews Landing Member of the Porters Creek into the adjoining Camp Hill and Whittentown Quadrangles. The brief description in the map legend indicates a lithology consisting of interbedded to interlaminated, pale yellow sand with common siderite concretions and nodules. This correlation is suspect as the lithologic description given by Thompson (2000a, b) is typical of the overlying Naheola Formation rather than the Porters Creek. The following evidence is offered as a discussion of this difference in interpretations.

(1) Formational Boundaries—As the Matthews Landing Marl Member is the uppermost unit in the Porters Creek Formation, the upper formational contact has a direct bearing on its presence or absence. A primary lithologic characteristic of the Naheola Formation is the interbedded pale yellow sand and clays which often exhibit a greenish-gray color. The Porters Creek consists of laminated dark gray clays with only minor, local sands. The description of the Matthews Landing provided by Thompson (2000a, b) is consistent with the lithologic description of the younger Naheola Formation. This description leads to the conclusion that his Porters Creek–Naheola contact has been placed within the basal Naheola Formation, rather than lower in the section at the point of lithologic change. Restricting the interbedded sand and clay section to the Naheola is traditional, dating to the work of Mellen and McCutcheon (1939), and the work of MacNeil (1946) in his work through Mississippi and Alabama, and more recently by Swann (1999), and Moyse (1999).

(2) Lithology—The Matthews Landing lithology is a fossiliferous, marine marl. Although the Porters Creek is marine and sections of the Naheola are also marine, there is no calcareous unit which could be assigned to a marl lithology. Within the Walnut Quadrangle, macro fossils are sparse in both the lower Naheola and the upper Porters Creek section—unlike the description of the traditional Matthews Landing. Toulmin (1977), does not recognize the Matthews Landing Member in his cross section which begins in Tippah County and MacNeil (1946) specifically states on his cross section that the Matthews Landing is absent in North Mississippi.

(3) Siderite Nodules and Concretions—Thompson (2000a, b) states siderite is common in his Matthews Landing section. The Matthews Landing is a marine unit, yet siderite is typically formed in freshwater depositional environments due to chemical considerations. Berner (1971) states (p. 199) " . . . as a result

marine siderite is rare. It has never been observed forming in modern marine sediments." The presence of siderite nodules suggests that the Matthews Landing section described by Thompson is not the marine depositional environment which is consistent with the traditional stratigraphic concept of both the Porters Creek and Matthews Landing. The Naheola Formation, however, does contain lignite beds and facies that could represent fresh water depositional environments which would be consistent with Thompson's descriptions.

These facts suggest that the "Matthews Landing Marl Member" of Thompson is actually higher in the section and part of the Naheola Formation, which also places his Porters Creek–Naheola contact west of where it would be if traditional stratigraphic assignments were used. Based on this mapping and previous work, there is no lithology consistent with the Matthews Landing Marl Member of the Porters Creek Formation present in the quadrangle or in Tippah County.

The Naheola Formation is the youngest unit of the Midway Group and conformably overlies the Porters Creek Formation. Recognition of the Naheola Formation in northern-most Mississippi is a result of the most recent mapping such as by Thompson (2000a, b). Earlier mapping assigned the lithologies now associated with the Naheola to various other units, most commonly some part of the Wilcox Group. Recent mapping has, therefore, separated the Naheola as a distinct mappable unit.

The Naheola outcrop belt is confined to the central and western half of the study area and extends into the adjoining Whitten Town and Camp Hill Quadrangles (Thompson, 2000a, b). Thompson subdivided the Naheola into its component Oak Hill and Coal Bluff Members. No attempt was made to map the subordinate Naheola members in this investigation, but Thompson's subdivision appears valid as there does appear to be a lithological basis for subdividing the formation.

The Naheola–Porters Creek contact is conformable and is defined by the lowest occurring sand bed above the gray, laminated clays of the Porters Creek section. The Naheola sands are typically fine-grained and often cross bedded, and are easily distinguished from the clay section of the Porters Creek. The Naheola clay beds are often a greenish-gray color and are interbedded with fine-grained sands. Iron oxide concretions are common in some parts of the Naheola section and represent weathered siderite nodules. An exception to the fine grain sizes is a zone near the middle of the Naheola which may contain coarse-grained sand and granules or clay clasts up to boulder size (Swann, 1999). A very thin Naheola section was cored in the MMRI-Martindale No. 1 well (only 12 feet [3.6 m]) near the top of the well. The overlying Meridian Sand is distinguished from the Naheola by a marked grain size change from the fine-grained sands and greenish-gray clays in the Naheola to the granule-containing, coarse- to medium-grained sands in the overlying Meridian Sand.

The Meridian Sand is the basal stratigraphic unit of the Claiborne Group and stratigraphically oversteps the older Wilcox and, more rarely, onto the Midway Group. This overstep was first suspected by Conant and McCutcheon (1941). Brown (1947, p. 34) also supported the overstep interpretation of the Meridian in his discussion of the Wilcox Group, "These strata are covered by overlap of the Meridian sand member of the Tallahatta formation in northern Mississippi." and states the outcrop pattern is "1 to 15 miles wide" in northern Mississippi. Lusk (1956) agreed with the overstep concept in adjacent Benton County as he mapped Meridian Sand to the Benton-Tippah County line. The Meridian overstep was also recognized in Tippah County in mapping conducted by Swann and others (1995), Swann (1999) and in Union County mapping by Moyse (1999). Although not mapped separately, Tourtelot (1964) also thought that some of the coarse-grained sands in the Tippah-Benton Bauxite District could be assigned to the basal Tallahatta Formation, i.e., the Meridian Sand. In contrast, Thompson (2000a, b) breaks with traditional interpretations of the stratigraphic section and does not recognize Meridian Sand in either the adjacent Camp Hill or Whitten Town Quadrangles, but, rather places the contact further west in the Slaydon and Holly Springs Quadrangles. Unfortunately, the reasons for this major reinterpretation of the section are unknown as there is no explanatory text accompanying his geological maps. Due to the lack of explanation for the reinterpretation of the Meridian section, the fact that the historic interpretation of several previous investigators support a Meridian Sand overstep, and the traditional interpretation for a Meridian Sand overstep appears to be a valid lithostratigraphic interpretation based on the stratigraphic code, the interpretation of Thompson (2000a, b) cannot be supported.

The Meridian Sand consists of fine- to coarse-grained sand with scattered granules or small gravel,

typically cross-bedded, and with subordinate clay lenses. The lower contact is perhaps the most notable in the study area with marked erosional relief beneath it, particularly where it oversteps the clays of the Porters Creek Formation. In some areas the clays underlying the contact are weathered, indicating the development of a paleosol. The relief associated with the erosion along the lower contact also complicates its mapping as it is seldom possible to project contacts with any accuracy.

The eastern edge of the Meridian Sand outcrop belt is characterized by a series of large channels or "channel complexes" incised into the underlying stratigraphic units and extending up dip onto older units forming the stratigraphic overstep discussed earlier. Centered on the town of Walnut, there is a large outlier that has been mapped as Meridian that overlies both lower Porters Creek and Clayton. This outlier was assigned to the Meridian due to its lithology, i.e., a cross bedded, medium-to coarse-grained sand, containing sparse, well rounded quartz gravel at its base. This lithology not consistent with younger terrace deposits as it lacked rounded, iron oxide cemented clasts, silt beds and did not contain the fining upward sequences characteristic of these Quaternary deposits. The Walnut outlier is also on trend with a large Meridian channel that continues westward into an eastward extension of the Meridian outcrop mapped by Lusk (1956).

Quaternary flood plains have also been mapped along the major fluvial components. These flood plains are typically well developed and are particularly broad in the Porters Creek outcrop belt. The largest flood plain is associated with Muddy Creek, a northward flowing tributary to the Hatchie River. Ditching and channelization along Muddy Creek dates from 1912 (United States Department of Agriculture, 1976).

The flood plains can vary significantly in lithologic characteristics, but typically consist of a fining upward sequence with clays at the surface. Outcrops are not common other than within the stream bottom or stream banks. The contact between the flood plain and valley walls is based, in part, on geomorphic criteria. The slope change, however, from flood plain to valley wall is so gradual in the Porters Creek outcrop that the geomorphic criteria were difficult to apply with great confidence.

Structure—The primary structural element in the study area is the Muddy Creek Fault Zone (Fig. 3) which has a northerly trend along Muddy Creek. Conant and McCutcheon (1941) suspected faulting in the Walnut-Muddy Creek area, but a lack of topographic maps made it difficult to identify fault trends or displacement. The environmental impact statement prepared for channelization work along Muddy Creek (United States Department of Agriculture, 1976) was more definitive, stating that there was structure in the Walnut area and noting a potential for hydrocarbons, though production was regarded as speculative. Bicker (1974) included a questionable fault trending northeasterly into northern Tippah County in his northern Mississippi cross section. There is, however, a significant difference in orientation between his fault and the Muddy Creek Fault Zone. Recent mapping adjacent and south of the study area has better defined the Muddy Creek Fault Zone and its southern terminus near Ripley, Mississippi (Swann and others, 1995; Swann, 1997, 1999). The northern terminus of the fault zone is unknown as it continues north of the study area into Tennessee. The Muddy Creek Fault Zone is interpreted as consisting of a set of *en echelon* faults rather than a single fault. The unusually straight valley walls of Muddy Creek appear to parallel projected component faults and may represent a fault line scarp.

Two parallel faults were mapped in the northwest corner of the study area in sec. 26 and 27, T1S, R3E. These faults displace Naheola and Porters Creek Formations, but the displacement is estimated at less than 20 feet (6.1 m). Another fault was mapped in sec.14 and 15 T2S, R3E. This fault trends almost east to west and displaces both the Porters Creek Formation and the overlying Meridian Sand. Displacement appears to be approximately 20 feet (6.1 m) with the downthrown block to the north.

A small northerly trending fault is mapped on the southern boundary of the map area (crossing Turkey Creek) and is the continuation of a fault originally described in Swann (1999). This fault lacks sufficient offset to completely displace the Porters Creek Formation, so displacement is difficult to determine. It is estimated to have 20 feet (6.1 m) or less displacement.

The top of the lower section of the Porters Creek Formation is often marked by an indurated, glauconitic siltstone or mudstone that can be used as a marker bed for structural mapping. Structure contours based on the elevation of this marker bed illustrate an elongate, northerly trending, positive structure situated west of the town of Walnut (Walnut Anticline). The crest of the structure is situated in part of sections 19, 30, and 31 of T1S, R4E; sections

25 and 36 of T1S, R3E; section 1, T2S, R3E; and section 6, T2S, R4E. The Blackwell No.1 and the Melton No.1, hydrocarbon test wells were drilled on structure, but south of its crest. The Martindale No.1 well was drilled off the west flank of the structure but little is known of the stratigraphy encountered in this old hydrocarbon test. The Melton No.1 well reported oil shows in the thick Paleozoic carbonate section. All of these wells were plugged and abandoned.

The Walnut Anticline is interpreted largely from surface mapping and could also be interpreted as a fault block associated with the adjacent Muddy Creek Fault Zone. The anticlinal interpretation is preferred because the lower Porters Creek siltstone marker bed elevation change is gradual rather than abrupt as would be expected if a fault boundary were crossed.

Hydrocarbon and Mineral Resource Potential—The hydrocarbon potential of northern-most Mississippi is largely unknown due to lack of exploration. There are no records, for example, from adjoining Benton County to indicate that there has ever been a hydrocarbon test well drilled within the county. The northern-most tier of counties in Mississippi (including Tippah County) is considered to be within the northern-most edge of the Black Warrior Basin. Present production (mostly gas) is south and east of the study area.

The Tertiary and Cretaceous sections in the study area, as is generally the case in the Black Warrior, are founded on an indurated Paleozoic section. The depth to the Paleozoic section is typically 1,100 feet (334.4 m) to 1,400 feet (425.6 m) in depth. From the few hydrocarbon test wells present in Tippah County, the stratigraphic assignments to the Paleozoic section are not without question, but it has been suggested that the top of this section is of Ordovician age. Some interpretations, however, assign at least parts of the Cretaceous subcrop to the basal Iowa Group (Mississippian). Regardless, the section consists of a thick sequence of limestones and dolostones with subordinate shales. The literature regarding the subsurface Paleozoic section in Mississippi is extensive, but work by Jennings (1994), Henderson (1991), Henderson and Gazzier (1989), and Schwalb (1982) should provide an overview.

The Memphis Equipment Co., No.1 Melton well is probably the most important hydrocarbon test in the study area. The No.1 Melton has a total depth of 5,302 feet (1,611.8 m) encountering the Paleozoic section (Ordovician?) at a depth of 1170 feet (355.7 m) and bottomed in what has been assigned to the Cambrian Copper Ridge. The Melton No.1 also contained a section referred to as the "reef facies." Examination of the cuttings from the Melton No.1 are of poor quality so it was difficult to determine the nature of this "reef facies." The cuttings did yield two fragments from the "reef" interval that appeared to be poorly preserved, algal limestone. The Smack-co. Ltd., No. 1 Blackwell, test well (with a total depth of 3200 feet [972.8 m]) is located approximately one half mile from the Melton well. An excellent set of cuttings sample descriptions was worked by the late Jack Henderson of the Mississippi Office of Geology for the No.1 Blackwell (sample descriptions are available from the Mississippi Office of Geology or the Mississippi Mineral Resources Institute). The "reef facies" is noted as consisting of chalk or "chalky limestone."

The presence of the Walnut Anticline, hydrocarbons shows in the cuttings of the Melton No.1, and a potential algal facies are important factors for possible hydrocarbon trapping and production. The presence, however, of only two wells on which to base evaluations, and the lack of a clearly defined seal in the upper section of the Paleozoic carbonates are of concern. The Paleozoic section below the Melton No. 1 is virtually unknown and may be worthy of further investigation.

Other mineral resources within the quadrangle include industrial clays and sands. These resources are associated with the Porters Creek Formation and the Meridian Sand respectively. The thick clay section of the Porters Creek is currently being used as a agricultural carrier, an absorbent, and for various specialty products. The wide Porters Creek outcrop belt suggests there is an abundance of reserves in the study area.

The Meridian Sand is used most often as a construction sand but may also have other applications. Outside the study area, washing the sand yields a usable masonry sand and it may also be suitable for specialty market sands such as filter sands (coarser grain sizes). The lower section of the Porters Creek Formation also contains sands, but they are typically fine- to very fine-grained and not as thick or laterally as extensive as those of the Meridian Sand. These sands are probably of limited economic significance.

CONCLUSIONS

Geological mapping in the Walnut, Mississippi–Tennessee, topographic quadrangle has identified five Cretaceous and Tertiary units cropping out with the quadrangle. These include the Cretaceous Owl Creek Formation the Tertiary Clayton, Porters Creek, Naheola Formations and the Meridian Sand. The Wilcox Group is not present in the study area with the Meridian Sand in unconformable contact with stratigraphic units of the Midway Group. This Meridian Sand overstep mapped in the study area supports earlier work in Tippah County and adjoining Benton County. The flood plains associated with existing fluvial components were mapped as a separate unit.

The Muddy Creek Fault Zone is the major structural feature and is interpreted as series of *en echelon* faults trending northerly along the course of Muddy Creek. The fault zone influences the outcrop pattern of the units of the Midway Group and appears to control the orientation of Muddy Creek, its flood plain and its eastern valley wall. The Muddy Creek Fault Zone continues into Tennessee, so the northern terminus is unknown. Other structures, such as the Walnut Anticline, are adjacent to the Muddy Creek Fault Zone and may be structurally related.

A structure contour map constructed using the claystone bed dividing the upper and lower Porters Creek Formation as a marker bed, suggests a positive structure west of Walnut (Walnut Anticline) with a northerly trend. All of the hydrocarbon test wells (three) are associated with this structure. The Memphis Equipment Co., Melton No. 1and the Smackco Ltd, Blackwell No. 1 wells all went to total depth in carbonate rocks of Paleozoic age. Oil shows were noted from the Melton No. 1, but little else is known. This structure may be worthy of additional investigations for the potential of deeper hydrocarbons. The Porters Creek Formation and the Meridian Sand contain industrial clay and sand, respectively, that are of economic significance to the region.

ACKNOWLEDGMENTS

The author would like to acknowledge the assistance of the Mississippi Office of Geology which obtained the core and cuttings from the MMRI-Martindale No.1 well that proved instrumental to the investigation. Mr. Rob Stewart and Ms. Cathy Grace (presently with EMS, Albuquerque, N.M. and the University of Mississippi, Department of Geology and Geological Engineering, respectively) assisted in core logging. Mr. Paul Mitchell, Mississippi Mineral Resources Institute, Technical Design Specialist, constructed the illustrations, and helped with completion of the digital version of the geological map. Ms Carol Lutken, Staff Geologist and Mr. Stephen Ingram, Sr., Research Associate, both of the Mississippi Mineral Resources Institute, provided editorial comments and suggested changes which improved the paper. Dr. Darrel Schmitz, Mississippi State University; Ms. Julie Kelley, U.S. Army Engineering Research and Development Center; and Mr. Rick Ericksen, Mississippi State Board of Registered Professional Geologists, served as external reviewers for the Journal. Their help is gratefully acknowledged and their comments and suggestions improved the paper. The author, however, bears the responsibility of the conclusions proposed in the paper and the implications thereof. The "words of wisdom" regarding Benton County geology, provided by Mr. Tracy Lusk, were greatly appreciated. The University of Mississippi Geoinformatics Center allowed us the use of their equipment and provided useful advice as we experimented with more efficient methods of producing digital geological maps.

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Mississippi Academy of Sciences
Board Meeting Minutes
June 28, 2003

[Every few years the Board has a retreat to assess the direction of the Academy. These are the unofficial minutes of that meeting.–ed.]

The regularly scheduled Board Meeting of the Mississippi Academy of Sciences was held on June 28, 2003, at Millsaps College in Jackson, Mississippi. The following members were present: Bob Bateman, Maria Begonia, Ham Benghuzzi, John Boyle, Ken Butler, Steve Case, Zelma Cason, Ann Curry, Ken Curry, Roy Duhe, Ibrahim Farah, Dick Highfill, Cynthia Huff, Aimee Lee, Sarah Lea McGuire, Joan Messer, Charles Swann, and Michelle Tucci.

Call to Order
Bob Bateman called the meeting to order and thanked the Board and Committee Chairs for their support during the last year.

Executive Officer
John Boyle reviewed the MAS balance sheet and noted that total assets amount to approximately $87,032.00. The year to date profit and loss statement indicates that the Academy presently has a positive cash flow for the past year.

After 13 years as MAS Executive Officer, John Boyle turned the responsibility over to Charles Swann. The Board applauded John Boyle for his dependable service to the Academy and welcomed Charles Swann. John Boyle will continue to manage the MAS web site and serve as Abstracts Chair.

Journal Editor's Report
Ken Curry reported that the July issue was in print and on the web site. The new issue includes the 2003 Dodgen lecture in print, an article with full color graphs and the first call for papers for the 2004 meeting.

Three papers submitted for the October issue have been returned to the authors for revisions. The journal editor continues to need help soliciting papers for the journal and reviewing articles submitted. Ham Benghuzzi agreed to submit two papers and Sarah McGuire is working on a review article. John Boyle suggested articles on the MAS linkage with the Institutes of Higher Learning and the Functional Genomics Network.

MAS Web Site Update
John Boyle reported that the July issue of the journal is on the web site and the MAS history is being put on the web site. It was suggested that approved minutes of the Board meetings be posted on the web site in the future. Publishing the minutes in the journal was discussed. It was suggested that a notice be printed in the journal directing interested individuals to go to the web site to view the minutes.

The abstract submission procedure will be modified for the upcoming meeting. Passwords will no longer be needed to submit an abstract. There will also be improvements to the format.

Cynthia Huff distributed information regarding the use of PayPal to allow credit card payment of membership fees, meeting fees and abstract fees when processing on line. The minimal cost to use their service should be offset by increased collections and efficiency.

Roy Duhe moved that MAS provide individuals the option of credit card payment through PayPal when joining, registering or paying fees on line. The motion was seconded by Bob Bateman and passed unanimously.

Meeting Registration Fees
After a brief discussion, Sarah McGuire moved that pre-registration fees for regular members be increased from $12 to $15 and that on-site registration fees be increased from $20 to $25. Student fees would remain at $5 for pre-registration and $10 for on-site registration. The motion was seconded by Roy Duhe and passed unanimously.

MAS Anniversary
Charles Swann noted that the Mississippi Academy of Sciences will be celebrating its 75th anniversary in 2005. John Boyle will head up a committee to coordinate the 75th anniversary commemoration. Updating the MAS history was discussed, and Charles

Swann will approach a graduate student about the potential project and estimate the cost for preparing the proposed update. A proposal will be submitted to the Board at the next board meeting.

Charles Swann is considering north Mississippi locations for the 2005 annual meeting. Proposals will be obtained from the following sites: the new Oxford Conference Center, The Grand Casino in Tunica and Whispering Pines in Olive Branch. Charles Swann will be approaching the University of Mississippi for sponsorship.

Committee Reports

AAAS/NAAS Representative
Steve Case noted that MAS is entitled to have two delegates at the national convention. Steve Case is presently willing to represent Mississippi, but pointed out that having a second delegate would be very beneficial to MAS. He explained that a second delegate would increase visibility for our state organization on the national level, allow MAS to have more influence with national issues and would allow for easier transition between delegates. It was noted that funding should not be an immediate issue since the travel expenses for the present delegate are being paid by his employer even though the expenses are budgeted each year.

After discussion, Steve Case was asked to suggest someone to serve as the second delegate. The delegate would be appointed by the President.

Youth Activities
Aimee Lee noted that MJAS nor the Youth Activity Committee are mentioned in the MAS By-laws. The Youth Activity Chair nor the MJAS director have a voice on the Board or voting privileges. The MAS web site also fails to mention MJAS. The Board agreed that this issue should be addressed. The President will appoint a committee to explore the need for a By-law change.

Information about MJAS will be added to the web site.

Cooperate Coordinator
Margot Hall and Jack Moody will Co-Chair the Cooperate committee.

Membership
Michelle Tucci and Aaron Puckett will Co-Chair the membership committee. A vision for increasing membership will be presented at the next meeting.

Nominations
Bob Bateman will chair the nominations committee.

Awards
Ken Butler and Kristina Stensaas will chair the Awards committee.

Annual Meeting 2004

Dodgen Lecture
Ham Benghuzzi announced that the Dodgen Lecturer for the 2004 meeting will be Dr. Herman Taylor. Dr. Taylor has the second largest grant in the United States for the Jackson Heart Study. In addition to Dr. Taylor, there will be three Plenary speakers to speak on Thursday and Friday mornings.

University Medical Center has agreed to sponsor the meeting. UMC has committed to provide audio visual equipment, a technical support person, and funding to support the Dodgen lecturer, the Board dinner and refreshments.

Exhibits
Elgenaid Hamadain has accepted responsibility for the Exhibits.

Abstracts
John Boyle will continue to process the abstracts.

Posters
Zelma Cason has accepted responsibility for the posters.

Program
Ann and Ken Curry will be putting together the program.

Local Arrangements
Ibrahim Farah and Rob Rockhold will Co-char the local arrangements committee.

Motions

1. The Board agreed to allow on-line credit card payment of fees through PayPal.

2. Meeting registration fees for regular members were increased to $15 for pre-registration and $25 for on-site registration.

Charles Swann., Executive Officer

President's Column

"Far and away the best prize that life has to offer is the chance to work hard at work worth doing."—*Theodore Roosevelt*

Let me start by expressing my gratitude for the opportunity to serve as this year's president. I am confident that the 68th Annual Meeting will be a success due to your scientific contributions. The Board of Directors, Chairs of Divisions and the Chairs of various committees have already been communicating and planning the events for the up coming meeting in Biloxi, MS. The efforts being made behind the scenes have been phenomenal, but in order to make the story complete we need your input and commitment to the Academy.

I envision our organization serving as a link between the different colleges and universities within our state, so that together we can disseminate the newest technologies, designs, theories and most importantly individual ideas.

Some may think that this dream is somewhat unrealistic or unattainable. I am convinced that if every one of us made an effort to encourage a colleague or student to come to the meeting and find out more about the Academy the circle would become broader with more diversity and strength. Over the past ten years, I have watched the Academy adapt and keep abreast of the changes occurring around us. Currently, more young faculty are becoming involved as well as an increase in student attendance. The Academy still focuses on enhancing student participation. The Academy has set the fees for the students members at a nominal $5.00. The amount of learning and fellowship that can be obtained by the student from the meeting is priceless. In fact, those mentors that do not insist that their graduate, residents or undergraduate students submit their findings and attend the meeting are actually doing them a disservice. This organization is an excellent opportunity for them to display their knowledge and build confidence before going to a national symposium. This year I would like to challenge the faculty who have students working toward a degree in their lab to encourage them to present their findings. For the faculty members that have not attended the annual meeting in while, I want to be the first to welcome you back.

I feel that this endeavor to promote science in our great state is one worth taking. Those of you that know me well understand that I will give 110% (as well as expect my team members to give at least 110%) effort in promoting the 68th Annual Academy of Sciences. If anyone after reading this feels the urge to jump on board to help us reach our goal, please contact me (hbenghuzzi@shrp.umsmed.edu) and I will see to it that your services are utilized. Once again, I invite all of you to join us in Biloxi, MS for an impressive scientific event.—Hamed Benghuzzi

Executive Officer's Column

The Mississippi Academy of Sciences (MAS) is supported and influenced by a wide variety of scientists residing largely in Mississippi. Without the active participation of these professionals the MAS becomes an irrelevant exercise and serves little purpose. The MAS Board of Directors and officers are agreed, that among their primary responsibilities is the need to ensure that the Academy is serving a useful purpose so that it is indeed relevant to its membership. By meeting this responsibility the MAS will also contribute to science as a whole, provide encouragement to future scientists, and provide a role model. Discussions among the officers at the last Annual Meeting in Hattiesburg, questioned if the MAS could not better meet this responsibility. Later, Dr. Bob Bateman, then MAS President, suggested we evaluate the MAS and hopefully define ways to ensure the relevancy of the organization and to encourage renewed participation and enthusiasm among the members.

The request for comments from the membership regarding ways the Academy could be improved was the first step in the self evaluation process. The membership response was plentiful. On June 28,

2003, Dr. Bob Bateman, convened a MAS Board Retreat at Millsaps College, Jackson, Mississippi. The membership comments were in many ways the guide to the discussion as to how the MAS could become a more meaningful part of the scientific community of Mississippi. The topics were far-ranging, discussed at length and well argued. A number of positive measures were agreed upon and should be evident at the upcoming meeting in Biloxi. You may notice, for example, the annual meeting has more activities to engage your interest, such as special symposia and additional, notable speakers. You may notice the MAS being recognized by other organizations such as Mississippi's Institutions of Higher Learning (IHL). The Mississippi Junior Academy of Sciences has already taken the initiative by contacting Mr. Bill McHenry of the IHL regarding working with IHL on their GEAR UP project. The MAS Board and officers also put their support of the *Journal of the Mississippi Academy Of Science*s in action by agreeing to submit articles for potential publication.

There are other initiatives we hope to have in place by the annual meeting, so watch for them. Dr. Ham Benghuzzi, the current MAS President , is enthusiastic about the upcoming meeting and is working to encourage a significantly higher attendance than last year. If you have additional ideas as to how to make the MAS better, please take the time to discuss your idea with any of the officers or Board members. I hope to have the opportunity to talk with many of you personally in Biloxi.—Charles Swann

MISSISSIPPI ACADEMY OF SCIENCES
Sixty-seventh annual meeting—February 2003
Late abstract

SPORE INDUCTION AND GENETIC MANIPULATION OF *BACILLUS* CULTURES

Vignesh Shettar, St. Andrew's Episcopal Upper School, Ridgeland, MS 39157

The purpose of this project was to determine how easy it might be to manipulate bacterial organisms intended for biological weapons' purposes. *Bacillus cereus* was selected as a model for this experiment since it is in the same genus as Anthrax and is also a gram-positive rod with the capability of producing spores. Initially, the log phase of bacterial growth was determined in order to establish optimal time frame for experimental testing. The first phase of the experiment induced spores under varying harsh conditions such as heat, cold, lack of nutrients, salt, and bleach. Spore to cell ratios from plate and broth cultures were counted. Secondly, *B. cereus* culture was manipulated to attempt to induce transformation and plasma uptake of pBlu and ampicillin resistant plasmids. This was done by heat shock and calcium chloride treatment of *B. cereus* cells in order to create openings in the bacterial cell wall through which plasmids could gain entrance to the cell. However, *B. cereus* cultures used in this study had apparently already been genetically altered to be ampicillin resistant thus resulting in growth on agar plates containing ampicillin. It was concluded that spore formation could be induced by a number of harsh means.

The Mississippi Junior Academy of Sciences

Call for Papers

Students in grades 9 - 12 are invited to submit research papers detailing their research projects to the Mississippi Junior Academy of Sciences Annual Research Paper Competition.

Deadline for entry: December 5, 2003 (entries must be postmarked by this date)

Send entries to:
Aimée T. Lee
Box 5018
Department of Biological Sciences
University of Southern Mississippi
Hattiesburg, MS 39406

Competition Date and Location: February 18, 2004
In conjunction with the Mississippi Academy of Sciences Annual Meeting
Biloxi, Mississippi

Call for Judges

The MJAS is meeting as a part of the Mississsippi Academy of Sciences. We look forward to sharing the student's achievements with all MAS members. Judges are needed for the MJAS Annual Research Paper Competition.

Three sets of judges are needed for the following areas:
Written Paper Judging (December 15, 2003)
Divisional Judging (February 18, 2004)
Overall Competition Judging (February 18, 2004)

All MAS members interested in becoming a judge should contact:

Aimée T. Lee
Box 5018
Department of Biological Sciences
University of Southern Mississippi
Hattiesburg, MS 39406
E-mail: aimee.lee@usm.edu
Telephone: (601) 266.6374

MAS AWARDS

Nominations Solicited

*The **Awards and Resolutions Committee** seeks nominations from the membership at large for awards to be presented at the Annual Meeting of the Mississippi Academy of Sciences:*

- **Outstanding Contributions to Science**
  Recognizes a member of the MAS whose research, teaching, or service to the community has significantly furthered the cause of science
- **Dudley F. Peeler Outstanding Contributions to the Mississippi Academy of Sciences Award (Peeler Award)**
  Recognizes a member of the MAS for long-term service to the Academy itself.
- **Community/Junior College Science Teacher**
  Recognizes a member of the MAS with outstanding accomplishment in the teaching of science at the community or junior college level
- **Secondary Science Teacher**
  Recognizes a member of the MAS with outstanding accomplishment in the teaching of high school science

These awards recognize the exceptional contributions of fellow MAS colleagues. To nominate **a current MAS member** for any of these awards, please specify the award category and submit the following:

a. **two supporting letters** from members of the Academy having firsthand knowledge of the nominee's accomplishments
   - Nominees for the **Outstanding Contributions to Science** should exhibit a commitment to the acquisition, dissemination, and application of scientific knowledge. An extensive research publication record by itself is not the only criterion on which nominations are considered.
   - Nominees for the **Peeler Award** should exhibit long-term, fundamental contributions toward the advancement of the Mississippi Academy of Sciences.
   - Nominations for either of the **Science Teacher Awards** must include a summary of the nominee's science teaching achievements as well as a summary of outstanding achievements of the nominee's students.

b. **curriculum vitae of the nominee**
   - Include educational background, professional experience, current position and work address, and both daytime and evening phone numbers as well as any other information considered to be pertinent for a specific award.

c. **additional letters of support** (optional)
   - Letters of recommendation from persons who are not MAS members will be accepted but are not required.

Send nominations to:
Dr. Kenneth R. Butler, Jr., Chair
MAS Awards and Resolutions Committee
219 Crescent Court
Brandon, MS 39047

If you have questions or comments, please do not hesitate to contact the Chair at 601-829-2826 (phone) or kbutlr@aol.com (email).

DEADLINE FOR ALL NOMINATIONS IS DECEMBER 1, 2003

The Jackson Heart Study Confronts the Heart of an Epidemic

Herman A. Taylor, Jr., M.D., F.A.C.C., F.A.H.A., Professor of Medicine

Dodgen Lecture
February 19, 2004

Dr. Herman A. Taylor, Jr., currently serves as Director and Principal Investigator of the new Jackson Heart Study, a landmark project sponsored by the National Heart, Lung and Blood Institute and the Office of Research on Minority Health of the National Institutes of Health. In that capacity, he holds appointments at Jackson State University, Tougaloo College, and the University of Mississippi Medical Center (Professor of Medicine). He received his undergraduate training at Princeton University and his medical degree from Harvard Medical School. Before completing his residency in internal medicine, he served 3 years in the Commissioned Corps of the Public Health Service in Miami, Florida. His work among the multiethnic population of inner city Miami solidified his career goal of working for improved health of American minority populations. After completing training in Internal Medicine at the University of North Carolina at Chapel Hill and a cardiology fellowship at University of Alabama at Birmingham (UAB), he was appointed to the UAB faculty. At UAB he served as Attending Cardiologist at the University Hospital, the Birmingham Veterans Medical Center and the Cooper Green Hospital. Prior to his present appointment, he was Associate Professor of Medicine and Director of Cardiopulmonary Rehabilitation at the University of Alabama at Birmingham School of Medicine. During his 9 years on faculty at UAB, he established interests in preventive cardiology, acute coronary syndromes, and ethnic disparities in cardiovascular health. He also founded Heart to Heart – a non-profit organization, which provides cardiac surgical services for children from the developing world.

Dr. Taylor has published numerous research articles in renowned journals such as Hypertension, The New England Journal of Medicine, American Journal of Cardiology, American Journal of Epidemiology, Achieves of Internal Medicine and Circulation to name a few. During his career, Dr. Taylor has received several prominent recognition awards. The most recent awards include the Preventative Cardiology Academic Award from the National Heart, Lung and Blood (NIH, 1995), The American Heart Association Distinguished Service Award (1997–1998), the Best Doctors in America Award (2001–2002) and most recently the prestigious Daniel Savage Award for Excellence in Research (2003).

As leader of the Jackson Heart Study, he envisions helping create a better understanding of CVD among African-Americans as a guide to effective strategies to improve health and eliminate disparities. Furthermore, the Heart Study will improve the research capacity of its partner institutions while helping train future leaders in the sciences of health.

Dr. Taylor resides in the Jackson, MS area with his wife, Jasmine Pugh Taylor, and their 3 children: Mathew, Johnathan and Jaylen.

8:30–9:15 AM—Plenary Session I

Audrey K. Tsao, M.D., Professor
Department of Orthopaedic Surgery and Rehabilitation
The University of Mississippi Medical Center
Jackson, MS

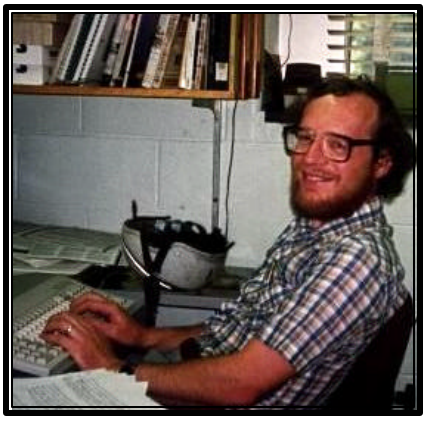
Dr. Tsao received her Bachelor of Engineering Science in Biomedical Engineering and Materials Science for Johns Hopkins University in 1982. She attended Weill Medical College of Cornell University and received her M.D. in 1986. After completing her orthopaedic residency at Northwestern University – McGraw Medical in Chicago, she completed a fellowship in Arthritis and Total Joint Reconstructive Surgery at Johns Hopkins University Good Samaritan Hospital in Chicago. Dr. Tsao has published numerous articles and has lectured extensively on her specialties, as well as being actively involved in biological research. In 1994, she coordinated a total joint workshop and currently has multiple grants on total joints and osteonecrosis related research. Dr. Tsao has held a faculty appointment in orthopaedic surgery at Johns Hopkins University before joining the University of Mississippi Medical Center and presently services on the Senate. A few of her professional memberships include the American Association of Hip and Knee Surgeons, the American Association of Orthopaedic Surgeons, National Osteonecrosis Foundation, the Orthopaedic Research Society, the Society for Arthritic Joint Surgery and the Society for Biomaterials.

Title: ORTHOPAEDICS AND ENGINEERING: THE CHICKEN AND THE EGG

Orthopedic principles of strain and stress and compressive forces for fracture fixation, piezoelectric bone healing and design of custom total joint replacements or rods and screws for fractures are primarily orthopedic science right? Or was that engineering for materials science, mechanical engineering and electrical engineering for that structure known as the human body. What about that monitor in the operating room for measuring oxygen levels or the electrical vectors of the heart. Didn't we just design that mobile device triggered by a puff of air to transport 200 LB mass 10 blocks that just happens to be a human body paralyzed from an auto accident? Engineering and orthopedics intimately related just pick the methods of personal interaction.

12:00–12:40 PM—Plenary Session II

Dr. Richard Alley and Dr. Joan Fitzpatrick



Dr. Richard Alley is a worldwide recognized expert on the history of climate change, especially as seen through the record preserved in the ice sheets and glaciers of the Arctic, Antarctic, and Greenland. Dr. Alley is a professor at Pennsylvania State University in the Department of Geosciences. Besides his many professional papers, he has served on a variety of panels and steering committees for the National Science Foundation. He was called upon to advise V.P. Al Gore on the climate change subject. His book, "The Two Mile Time Machine," a development of the climate history found in continuous ice cores, is in its second edition.

Dr. Joan Fitzpatrick is with the United States Geological Survey and managed the national ice core laboratory. As such, she was intimately involved in the United States effort to unravel the mystery of climates past and their lessons for the future. Among her many publications and professional presentations was a talk she gave to the Mississippi Geological Society several years ago. It was, without a doubt, one of the most informative and thought-provoking addresses the society has heard.

Title: CLIMATE CHANGE: ITS HISTORY AND FUTURE

This world we live in has kept excellent records of its past activities in the rocks, sediments, and continental ice sheets. Through time, some of that excellent record is destroyed, but some, or at least enough, is preserved. This preserved record begs to be read so that its story and lessons may be known. With the present level of political and popular attention focused on climate change, it is important that science be called upon to present the facts as they are known and understood at this time of critical decision making.

Many scientists from all over the world are working on all aspects of climate change, its past and future. The Mississippi Academy of Sciences is very pleased to bring two such distinguished scientists to our Biloxi meeting.

12:00–12:40 PM—Plenary Session III

Dr. Joseph A. Cameron, Professor and Director of Graduate Program
Director of Minority Institutional Research Training Program
Former Director of Community Mobilization, Jackson Heart Study
Director of the Bridges to the Baccalaureate Degree Program
Department of Biology, Jackson State University, Jackson, MS

Dr. Joseph A. Cameron received the Ph.D degree from Michigan State University in 1973. He currently holds the position of Professor of Biology at Jackson State University and has held this position since 1978. During his tenure at Jackson State University, Dr. Cameron has developed many graduate and undergraduate courses and has been appointed as coordinator of the graduate program since 1985. He has also served as Interim Dean, School of Science and Technology. Dr. Cameron's greatest contribution to Jackson State University is his desire to enhance and generate an interest in science throughout the educational pipeline, i.e. high school, junior college, college and doctoral degree levels. NIH has funded Dr. Cameron since 1985 to encourage students at these various levels. From 1986 to 2002, Dr. Cameron served as the Director of the Minority Institutional Research Training Program at Jackson State University. The program was sponsored by the National Heart, Lung, and Blood Institute and had an annual budget of 193,000 dollars. The program was a cooperative research-training project between Jackson State University and the University of Mississippi Medical Center. The primary purpose of the program is to identify, motivate, and train talented minority institutional pre-doctoral students. Dr. Cameron is also the former Director and Chief Administrator for the Community Mobilization component of the Jackson Heart Study. The program is sponsored by the National Heart Lung and Blood Institute in conjunction with the Office of Research on Minority Health. The program is a cooperative, interinstitiutional, epidemiological study of cardiovascular disease between Jackson State University, Tougaloo College and the University of Mississippi Medical Center. Dr. Cameron also serves as Director of the Bridges to the Baccalaureate Degree Program at Jackson State University**.** The program is sponsored by the National Institute of General Medical Sciences and has an annual budget of 200,000 dollars. The program is a cooperative research-training project between Jackson State University and Hinds Community College involving the Departments of Biology, Chemistry, Computer Science, Mathematics, and Physics. The program encourages Community College minority students to seek B. S and higher degrees. Dr. Cameron also serves as Coordinator of collaborative Bridges to the Doctorate Degree Program with Indiana University Purdue University at Indianapolis and the University of North Texas at Forth Worth. These are just a few of the many federally funded programs for which Dr. Cameron has served as director. Dr. Cameron is well respected at NIH and has served as Chair/Member of many Special Emphasis Panels at the National Heart, Lung and Blood Institute, National Institutes of Health, as well as Member of many Special Emphasis Panels at the National Center for Minority Health Disparities, National Institutes of Health. Dr. Cameron has also found time to publish as well as mentor students. He has published numerous journal articles and has produced over 40 Master level students. Dr. Cameron's goal is to serve his community through education.

Title: BRIDGES TO THE BACCALAUREATE DEGREE PROGRAM: A METHOD TO RECRUIT AND TRAIN THE NEXT GENERATION OF BIOMEDICAL ENGINEERING RESEARCH SCIENTISTS

The goal of the Bridges to the Baccalaureate Degree Program at Jackson State University and Hinds Community College is to facilitate the transi-

tion of underrepresented Community College students into Baccalaureate Degree Programs. The University of Mississippi Medical Center consults and assist program faculty with the provision of programs strategies, including academic enrichment activities, laboratory techniques and research experiences. Modern technological concepts, cognitive skills and diagnostic laboratory procedures in Chemistry, Computer Science and the Biological Sciences are reinforced in academic year activities. The academic year component has been an effective preparatory strategy for summer research activities as indicated by student interest and mastery of biotechnological research techniques and concepts. A Southeastern Regional Bridges Research Conferences is held annually to allow students in participating Bridges Programs the opportunity to present research results before regional interstate peers and program faculty. Faculty, student and interstate peer assessment of student and program activities also reflect the success of academic enrichment and summer research-training activities. Additional program provisions include: curricular enrichment, guest faculty lectureships, mentoring tutoring, counseling, senior college course credits and exposure to biomedical professionals. Activities are conducted on Saturdays during academic year and weekdays for eight weeks in the summer. The goal of the Bridges to the Doctorate Degree Program is to facilitate the transition of underrepresented masters level students to doctorate degree programs in the biomedical sciences at IUPUI and the University of North Texas at Forth Worth. Students are provided research support, mentoring, travel to scientific meetings and exposure to biomedical professionals at the doctorate and masters level institutions.

MISSISSIPPI ACADEMY OF SCIENCES ABSTRACT FORM/MEMBERSHIP FORM

ABSTRACT INFORMATION

Abstract title_____

Name of presenting author(s)_____
(Presenter must be a current (i.e., 2004 membership dues must be paid) student member, regular member, or life member of the MAS)

Telephone_____ Email _____

Check the division in which you are presenting

___ Agriculture and Plant Science	___ Health Sciences	___ Physics and Engineering
___ Cellular, Molecular and Dev. Biol.	___ History and Philosophy of Science	___ Psychology and Social Sciences
___ Chemistry and Chem. Engineering	___ Math., Computer Sci. and Statistics	___ Science Education
___ Ecology and Evolutionary Biology	___ Marine and Atmospheric Sciences	___ Zoology and Entomology
___ Geology and Geography		

Type of presentation

___ Poster presentation ___ Workshop
___ Lecture presentation ___ Invited symposium

*If the presenting author for this paper is also presenting in another division, please list the other division:*_____

Audio-visual equipment needs

___ 2" x 2" slide projector
___ Overhead projector

Other audio-visual equipment including computers and computer projection equipment must be provided by the speaker.

MEMBERSHIP INFORMATION

New ___ Renewal ___
Mr. Ms Dr._____
Address_____
City, State, Zip _____
School or Firm _____
Telephone_____ Email address _____
PLEASE INDICATE DIVISION WITH WHICH YOU WISH TO BE AFFILIATED _____

Regular member $25	Student member $5	Life member $ 250
Educational $150	Corporate Patron $1000	Corporate Donor $500

CHECKLIST

The following MUST be DONE:

___ Enclose copy of abstract (even if abstract has been submitted electronically)
___ Complete and enclose abstract form /membership form(this form)
___ Enclose the following payments (make check payable to Mississippi Academy of Sciences):
  ___ $25 per abstract
  ___ $25 regular membership fee OR $5 student membership fee (2003 membership must be paid for abstract to be accepted)
___ You must supply a check #_____ or P.O. # _____ (credit cards are not accepted)

In addition you MAY preregister at this time:

___ Enclose the following payments:

___ $25 regular member (after 15 Jan.)	___ $15 regular member (Preregistration before Jan. 15, 2004)
___ $10 student member (after 15 Jan.)	___ $ 5 student member (Preregistration before Jan. 15, 2004)
___ $50 nonmember (after 15 Jan.)	___ $40 nonmember (Preregistration before Jan. 15, 2004)

NOTE: **Abstracts that are resubmitted for changes will incur a $10 resubmission fee. Late abstracts will be accepted with a $10 late fee during November increased to $25 after that. Late abstracts will be accepted only if there is room in the appropriate division.** They will be published in the April issue of the MAS JOURNAL.

MISSISSIPPI ACADEMY OF SCIENCES—ABSTRACT INSTRUCTIONS
PLEASE READ ALL INSTRUCTIONS BEFORE YOU SUBMIT YOUR ABSTRACT

- Your paper may be presented orally or as a poster. Oral presentations are generally 15 minutes although some divisions allow more time. The speaker should limit a 15 minute presentation to 10–12 minutes to allow time for discussion; longer presentations should be limited accordingly. Instructions for poster presentations are given on the reverse side of this sheet.
- Enclose a personal check, money order, institutional check, or purchase order for $25 publication charge for each abstract to be published, payable to the Mississippi Academy of Sciences. The publication charge will be refunded if the abstract is not accepted.
- The presenting author must be a member of the Academy at the time the paper/poster is presented. Payment for membership of the presenting author must accompany the abstract.
- Attendance and participation at all sessions requires payment of registration.
- Note that three separate fees are associated with submitting and presenting a paper at the annual meeting of the Mississippi Academy of Sciences. (1) An abstract fee is assessed to defray the cost of publishing abstracts and (2) a membership fee is assessed to defray the costs of running the Academy. (3) Preregistration payment ($15 regular; $5 student) may accompany the abstract, or you may elect to pay this fee before January 15th, or pay full registration fees at the meeting.
- Abstracts may be submitted by e-mail or entered directly through the MAS website. The URL is http://www.msacad.org. This abstract submission form and the appropriate fees should be sent by US mail even if the abstract has been submitted electronically.
- Abstracts may be submitted as a WordPerfect, Word, ASCII, ANSI, or .RTF file on a PC readable diskette. *Formatting should be minimal*. This abstract submission form and the appropriate fees should be sent by US mail even if a diskette is used for the abstract.
- Abstracts may be submitted typed or printed on clean white paper. Abstracts received in this form will be scanned into a computer. Leave ample margins and use a sanserif type font to help minimize errors in scanning.
- **Abstracts that are resubmitted for changes will incur a $10 resubmission fee.**
- **Late abstracts will be accepted with a $10 late fee during November increased to $25 after that. Late abstracts will be accepted only if there is room in the appropriate division.** They will be published in the April issue of the MAS JOURNAL.
- Submit your abstract and appropriate fees to the Abstracts' Editor, John Boyle, **TO BE RECEIVED NO LATER THAN OCTOBER 31, 2003**.
- Late abstracts will be accepted with a $10 late fee and only if there is room in the appropriate division. They will be published in the April issue of the MAS journal.

Dr. John Boyle
Mississippi State University
Dept. of Biochemistry
P.O. Drawer 9650
Mississippi State, MS 39762

FORMAT FOR ABSTRACT

- Your abstract should be informative, containing: (a) a sentence statement of the study's specific objectives, unless this is given in the title; (b) brief statement of methods, if pertinent; (c) summary of the results obtained; (d) statement of the conclusions. It is not satisfactory to state, "The results will be discussed."
- Your abstract, including a concise, descriptive title, author(s), location where work was done, text and acknowledgment, may not exceed 250 words. **Excessively long abstracts will be truncated**
- The title should be all capital letters. Use significant words descriptive of subject content.
- Authors' names start a new line.

- The institution where your research was done should include city, state, and zip code. Do not include institutional subdivisions such as department.
- The abstract should be one paragraph, single spaced, starting with a 3-space indentation.
- Use standard abbreviations for common units of measure. Other words to be abbreviated, such as chemical names, should be spelled out in full for the first use, followed by the abbreviation in parenthesis. Do not abbreviate in the abstract title.
- Special symbols not on your printer or typewriter must be in black ink.
- Use italics for scientific names of organisms.
- Begin authors' names on a new line. Place an asterisk (*) after the presenter(s), if there are multiple authors.
- Use superscripts for institutional affiliations where necessary to avoid ambiguity.
- Refer to these examples as guides.

EXAMPLES OF TITLES AND AUTHORS:

[single author, no ambiguity about designated speaker or affiliation]
AN EXPERIMENTAL MODEL FOR CHEMOTHERAPY ON DORMANT TUBERCULOUS INFECTION WITH PARTICULAR REFERENCE TO RIFAMPICIN
Joe E. Jones, Mississippi State University, Mississippi State, MS 39762
Abstract body starts here . . .

[two authors, both designated as speakers, different affiliations, but no ambiguity]
AN EXPERIMENTAL MODEL FOR CHEMOTHERAPY ON DORMANT TUBERCULOUS INFECTION WITH PARTICULAR REFERENCE TO RIFAMPICIN
Joe E. Jones* and Ralph A. Smith*, Mississippi State University, Mississippi State, MS 39762, and University of Mississippi Medical Center, Jackson, MS 39216
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Joe E. Jones[1], Ralph A. Smith[1]*, and Alice D. Doe[2], [1]Mississippi State University, Mississippi State, MS 39762, and [2]University of Mississippi Medical Center, Jackson, MS 39216
Abstract body starts here . . .

GUIDELINES FOR POSTER PRESENTATIONS

- The Academy provides poster backboards. Each backboard is 34" high by 5' wide. Mount the poster on the board assigned to you by your Division Chairperson. Please do not draw, write, or use adhesive material on the boards. You must provide your own thumb tacks.
- Lettering for your poster title should be at least 1" high and follow the format for your abstract. Lettering for your poster text should be at least 3/8" high.
- Posters should be on display during the entire day during which their divisional poster session is scheduled. They must be removed at the end of that day.
- Authors must be present with their poster to discuss their work at the time indicated in the program.

The *sixty-eighth* annual meeting of the

Mississippi Academy of Sciences

will be held on
Thursday and Friday,
February 19 and 20, 2004

Biloxi, Mississippi

Accommodations will be at
President Casino Broadwater Towers
2060 Beach Boulevard
1-800-843-7737